MACHINERY.

Vol. 5. July, 1899. **No. 11.**

BICYCLE CHAINS.

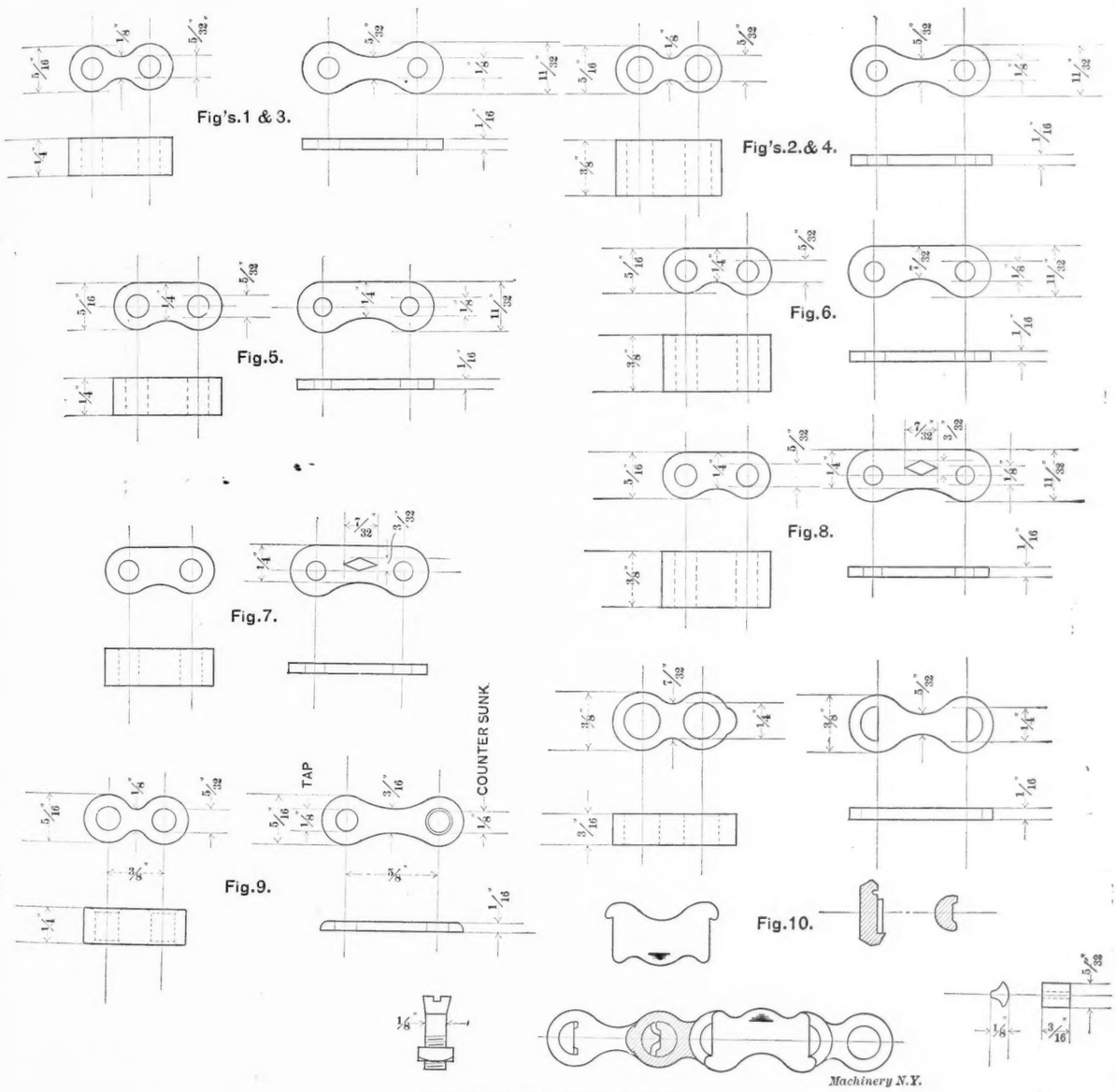
THEIR STRENGTH AS DETERMINED BY EXPERIMENT—DESCRIPTION OF THE DIFFERENT CHAINS.

GEO. H. WALTMAN.

When John Quincy Adams was President of the United States in 1827, a secretary of the legation from England, who was recognized as one of the leaders in Washington society, created a sensation one day mounted on a velocipede imported from London. He had two wheels with a saddle between and pushed along with one foot on each side. Afterwards cranks were attached to the front wheel.

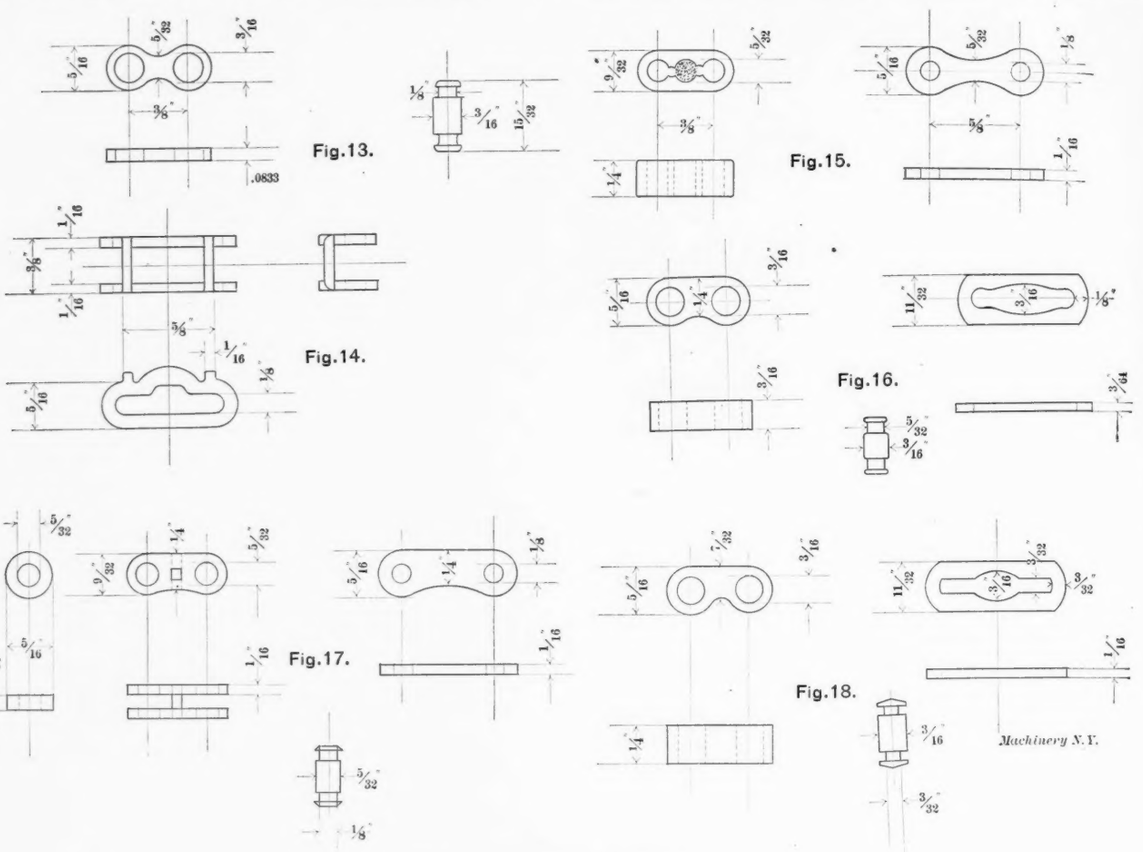
Practice proved that the velocipede was awkward and jolty with its iron tires. It was hard to ride because of the location of the saddle and it was hard to push because the power was applied to the steering wheel. Only a few of these velocipedes were made, and they were generally seen in the hands of the Indian or the funny man who passed through the town and stopped only for a day.

The first "ordinary" bicycle was built in Boston, Mass., in the year 1877, from a model brought from England, and this model was displayed at the Centennial Exposition at Phidadelphia, Pa., in 1876. This "ordinary" was a wonderful advancement over the old velocipede. The rider stood over the steering wheel and so had no difficulty in propelling the bicycle when turning a corner. This construction led to an increase in the size of the forward wheel with pronounced advantages. A tall man man could ride a high wheel and easily outrun a short man with a low wheel.



DIMENSIONS OF LEADING CHAINS.

The safety was introduced to the public and put on the market in its present form in the season of 1889. The reason for its existence is evident from the name. No more headers were experienced and in addition the stout man could have gearing of high ratio and accomplish as good results as the tall, slender man with a high wheel. The safety at once became practical,



DIMENSIONS OF LEADING CHAINS.

swift and popular. Now, over seven million safeties are in use in the world; some two or three million of these in the United States.

In these days when there are so many styles and makes of bicycles, it is verily a puzzling task to decide which wheel to purchase. The price is generally reasonable, however, for the clashing and competition of the different firms have lowered the price of the different wheels to such a degree that we are sometimes inclined to doubt the worthiness of the cheaper ones. There is no reason, however, why the reduction in the price should materially lower the grade of the cheaper wheels, for steel is worth only nineteen cents a pound and the automatic and semi-automatic machines now used for producing the parts turn them out at a phenomenally low cost of production.

The bearings, brake, saddle, tire and chain have all received a share of attention, but the chain still appears to be a bone of contention, and the many substitutes offered for its use in the form of gears have all met with more or less failure or success. As to the utility of these devices, every sound thinking mechanic knows that bevel gears are most emphatically to be avoided if efficiency is a consideration, except, possibly, in very exceptional cases.

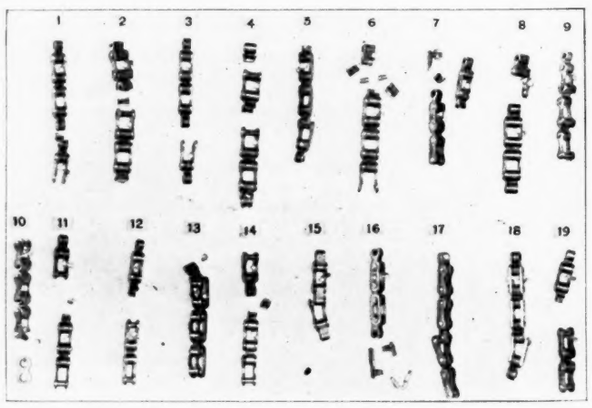
The present makes of chainless wheels do not seem to be winning a high degree of favor by the cycling public, and, as the chain is likely to remain with us for some time, it is a subject worthy of consideration to those interested in wheels.

The sample chains in the following illustration of tests were obtained for the purpose of investigating the strength and merits of the principle makes of chains, and in no case was a sample obtained for advertising purposes.

The sketches will serve to give a clear idea of the details of some of the chain parts and show fully the comparative sizes. All of the chains tested, however, are not represented in these sketches. In the table will also be found the names of the makers of the chains, number, tensile strength in pounds and the strength of the material per square inch of section in pounds, by which an idea may be formed of the grade of material used in the manufacture of the chains.

No. 1 to No. 8 inclusive, show the different styles and sizes made by the Indianapolis Chain and Stamping Co., Nos. 1 and 3 and Nos. 2 and 4 being duplicates.

The fracture in No. 6 occurred first in the center of the rivet, after which the ends of the blocks tore apart. No. 7 first broke at the end of the block. The "Victor" chain, No. 9, is assembled by the use of a bolt and nut at every other block, and in this case the weakest point appears to be in the counter-sink hole in the side plate for the bolt head.



THE CHAINS AFTER BREAKING.

No. 10 is the "Morse" detachable roller-bearing chain, which has the advantage of being readily taken apart and assembled when occasion requires. Reference to the sketch will make clear to the reader the details of the chain.

The Morse chain, as made the present season, is somewhat different from the sketch shown. The block has been omitted

and side plates substituted instead, which are kept the proper distance apart by a newly added roller on the pin. They call the new chain the Morse Twin Roller chain, which has the apparently favorable combination of a roller and a detachable chain.

No. 11 and No. 12 are two sizes, ¼" and 3-16", respectively, of the "Miami" chain, and are in general principle similar to the Indianapolis chain.

The block in the "Myers" chain, No. 13, is composed of three individual blocks placed side by side, while the side plates on opposite sides are stamped from one piece and bent the proper shape to accommodate the rivets and blocks. The "Myers" is another form of the detachable chain. Nos. 14 and 15 are chains used on Wolf-American and Columbia wheels, respectively. The latter, as formerly made, has a hole drilled through the center of the block in the same direction as the rivet hole, and is filled with a small piece of cotton or felt material, which is saturated with oil and intended to carry a supply of lubrication for the rivets. As made this year, however, the chain does not have the oil pockets. No. 16 is another form of detachable chain made by the "Crescent" people, and is quite easily assembled and taken apart. The "Thames," No. 17, is a departure from the usual form, inasmuch as it is provided with a roller on the end of each block which, instead of sliding off the sprocket and tooth, has the advantage of rolling off and lessening the friction.

TABLE OF RESULTS OF TESTS.

Name of Chain.	Chain Number.	Tensile Strength in Pounds.	Strength of Material in Pounds per Square Inch of Section.
Indianapolis, No. 2 single	1	1,300	53,000 shear.
" No. 2 tandem	2	2,000	34,000 tension.
" No. 3 single	3	1,450	59,450 shear.
" No. 3 tandem	4	1,930	32,810 tension.
" No. 5 single	5	1,320	49,120 shear.
" No. 5 tandem	6	1,400	89,600 tension.
" No. 7 D single	7	1,490	37,250 "
" No. 7 D tandem	8	1,550	63,550 shear.
Victor	9	1,190	49,385 tension.
Morse	10	1,520	95,000 "
Miami ¼"	11	1 600	40,000 "
" 3/16"	12	1,220	40,260 "
Myers	13	1,400	57,400 shear.
Wolff	14	1,140	44,220 tension.
Columbia	15	1,735	71,135 shear.
Crescent	16	1,210	85,910 tension.
Thames	17	1,430	58,630 shear.
Baldwin	18	1,500	74,250 "
Tribune	19	9 0	30,720 tension.

The "Baldwin," No. 18, is also made detachable. The advantage of the detachable chain will readily be appreciated by the reader if he has had occasion to repair his chain while on the road, ten miles from the nearest repair shop.

The "Tribune," No. 19, is similar to the Indianapolis chain in construction.

While these tests do not reveal all the qualifications of the chains, they are an aid in forming an idea of the relative strength, the excellence of design and material employed. In every case, however, it will be seen that a high factor of safety is used, as the actual strength of the chain is considerably in excess of the pull on the chain while in actual service. For, suppose we consider the case of a man weighing 200 pounds placing his entire weight on one crank (a condition not often met with), and assume that the crank is seven inches long, is in a horizontal position and that the radius of the front sprocket is four inches. We then find the actual pull exerted on the chain to be $\frac{200 \times 7}{4} =$ 350 lbs.

The ability of a chain to resist wear is an important item to be considered and while some chains may show a very high tensile strength, it does not necessarily follow that they would run the longest, since those chains which are designed to reduce the wear generally give the best results in the end.

The question of the lubrication of the chain is one upon which nearly every rider has a different opinion. Some use a lubricant, and others prefer to let the chain run dry. It will probably require no demonstration to convince the reader that there is considerable friction in the chain and an examination of the link blocks and teeth of the sprocket will make it evident that there is wear resulting from this friction. This wear causes that bad feature known as "stretch," which is bound to exist, no matter how carefully a chain is designed to obviate the trouble. Since there are friction and wear to contend with, the chain links ought to be lubricated, either with graphite or oil or both.

If with oil, a means must be devised to protect the clothing from becoming soiled and the chain from collecting dust, thereby increasing the friction and wear. The gear-case for this reason is receiving much favor and there seems to be no reason why, when employing a means of this nature to keep the dust and dirt from the chain, it could not be allowed to run freely immersed in a bath of oil contained within the case.

Another method of oiling a chain and a good way to clean it of all sticky oil substance is to soak it for several hours in warm kerosene, after which every particle of foreign matter is thoroughly softened and can be removed with the aid of a short, stiff brush and dried with a bit of waste. When all the kerosene has been dried and allowed to evaporate from the joints, it is again left to soak, this time in a good, clean lubricating oil, not too thick or gummy. On removing the chain from the oil and wiping off the superfluous oil it will be in a clean condition, with no oil apparent on the outside, but with the joints themselves nicely lubricated and capable of running for a long period before a repetition of the cleaning and oiling process is found necessary.

Again, the chain should not be allowed to run too loose, as it is liable to "ride the sprocket teeth," causing an undue strain, and snap, which, under these conditions, usually occurs when coasting, much to the discomfort and danger of the rider. It is therefore well to select a chain designed to produce the least wear and lessen the amount of "stretch" to a minimum.

If the claims of the detachable chain should not appear feasible to the reader, another good plan to accomplish the same object is to have the chain composed of five or six individual sections, each joined to the other with the usual bolt and nut, and in the event of a link breaking, another section, carried in the cyclist's kit, may quickly replace the one broken.

* * *

Now is the time when every draughtsman wishes that the office in which he has to spend his time were equipped with electric or power fans to dispel the heat and clarify the atmosphere, to say nothing of blowing away the cobwebs from his overheated brain. It is an unpleasant fact that the drawing room is generally the warmest and most uncomfortable room about a manufacturing plant, outside of the boiler room. It is usually located on the top floor near some tin roof, so that there will be plenty of light and a good opportunity for blue-printing. This location, called for by the conditions mentioned, is necessarily a hot one and anyone can verify the fact that hot drawing rooms are not conducive to energetic or careful work on the part of the occupants. Fans are cheap and they can be operated at a cost that is not appreciable in any factory. There can be no question but that for a really first-class investment nothing will pay a manufacturer better than to equip his drawing room with this simple means of comfort. One mistake in the drawing room may mean dollars lost in the shop, and one bright idea evolved in the drawing room may be the means of making many dollars in the shop every year. There is nothing more conducive to mistakes than hot, uncomfortable quarters, which give everybody a don't care kind of a feeling, and it is quite certain that the bright ideas originating in such a place will be conspicuous by their absence.

* * *

A SAFE FORM OF FLY-WHEEL.

Our readers will be interested in the form of safety fly-wheel described by Mr. John Fritz at the last meeting of the American Society of Mechanical Engineers and to which reference was made in the last number of this paper. This wheel is the outgrowth of the demands of rolling mill practice, where the duty is perhaps more severe than in any other place where fly-wheels are used. With the introduction of steel came the necessity for larger rolls for the mills and larger fly-wheels, which led to the adoption by Mr. Fritz, of the type shown in the accompanying sketch.

As indicating how the requirements for this class of work have grown since the early days, Mr. Fritz explained that wood was formerly used in the construction of fly-wheels to as great an extent as possible. The men who built or looked after the wheels were called millwrights or forge carpenters, and all of the earlier wheels had wooden arms of hard wood, locust or white oak being preferred. The segments were in halves and secured together with gibs and keys. Having no machine tools when these wheels were built, they were put together practically as

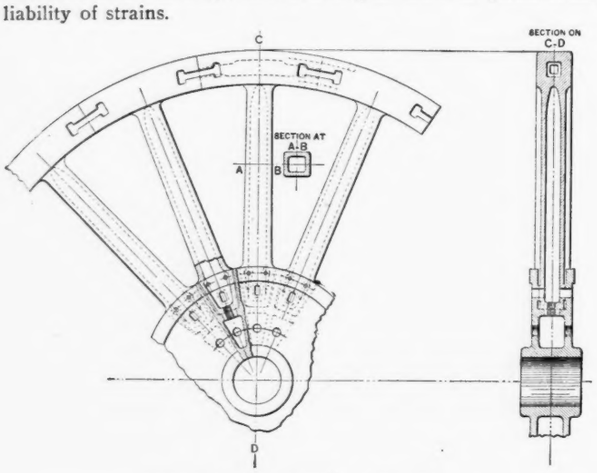
the castings came from the foundry, with the lumps and swells chipped off with a two-handed chisel and sledge, which naturally caused a weak wheel. They were made of cold blast charcoal iron, which was greatly in their favor, and no doubt this fact prevented many accidents.

In the course of time the millwright and carpenter were displaced by the machinist, and with the introduction of machine tools, especially the planer, the wheels were better fitted up, but not much safer, in consequence of the use of iron, made from mineral coal, in place of charcoal.

Mr. Fritz recounted the following vivid illustration of the tremendous strains to which rolling mill fly-wheels are subjected.

"Let us for a moment think of a fly-wheel twenty-six feet in diameter, sixteen-inch rim, making from seventy to eighty revolutions per minute, rolling a steel bloom into a rail. When about one-half done, say, about sixteen feet in length, instead of the piece going straight out, through the rolls on the guides, as intended, it sometimes wedges in the groove, and in less than a second of time it has completely encircled the roll, and forms what in rolling-mill phrase is called a collar, and continues to wind around the roll until something must happen, either the breaking of a roll, a spindle or coupling, or the engine must be brought to a standstill in an almost incredibly short space of time. The tortion on the spindles and couplings is so great that it causes the wheel to rebound. To calculate the strain the wheel is subjected to under these conditions will require someone better posted in mathematics than I am."

Referring to the illustration, it will be seen that the segment is cast hollow, and also the arms, which are made at the ends to compare in thickness to the segment, so as to relieve them of strains which might occur if the segments were cast solid. The holes in the segments are small at the ends, so as to make up for the metal taken out for the tees. The links, or tees, are different lengths, so that the strain on the segments will not come all at one place, and by using oil-tempered steel in the links, or double tees, the rim will be practically as strong at the joints as it is elsewhere. There are no abrupt changes in the thickness of the castings, thus avoiding as much as possible the liability of strains.



SKETCH OF MR. FRITZ'S FLY-WHEEL.

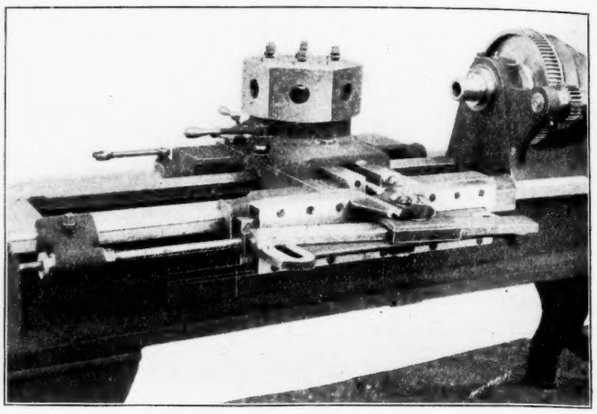
The joints in the segments are generally the weak part of a wheel. In this respect a wheel made from the drawing shown would be stronger than the original wheel, as the tees in the segments in the wheel now in use were made of wrought iron, and would probably not stand over 50,000 pounds tensile per square inch, while Mr. Fritz said, if he were to build another, he would use steel that would stand at least 85,000 pounds tensile stress. This would make the joints practically as strong as the segments.

It will be noticed there is a space in the center of about one-quarter inch in the front and rear side of each arm. This is filled with oakum and driven hard, after the wheel is finished and in place, to keep the arm from yielding in the direction of the strain, and at the same time it greatly lessons the work of fitting up the wheel. The one and three-quarter inch round holes through the center and arm are reamed out and steel pins made and turned so that they will drive in snugly.

A TURRET ENGINE LATHE.

The illustration accompanying this shows the arrangement of the turret as applied by the Springfield Machine Tool Co., Springfield, O., to their standard type of 18" lathe. The demand for rapid lathe work, not alone when working from the bar, but in finishing pieces held in the chuck or clamped to the face plate, has led to the adoption of the turret on the carriage for a great variety of work, in place of the regular compound rest.

This lathe is designed to serve the purpose of a heavy turret lathe and with the exception of the turret on the carriage, and of the abolition of the tail stock and compound rest, the lathe is of the regular design. The carriage is heavy, is gibbed to the outside of the bed, both front and back, and is fitted with a turret slide 10" in width and 16" in length. The hexagonal turret



VIEW OF THE TURRET AND CARRIAGE

is 10¼" in width across the flats. The holes in the turret may be as large as 2" in diameter, and the construction is such that a bar may be passed entirely through the turret, which permits a bar of any length to be used, in which respect it has the advantage over the pilot wheel type of machine. The index pin and clamping lever are on the right side of the turret.

The lathe is provided with power cross-feed as well as longitudinal feed and screw cutting apparatus. It may also be equipped with taper attachment if desired. This attachment is shown in the illustration, and is of the modern type which is supported by the carriage instead of by brackets sliding on ways at the back of the bed. The attachment is kept from moving by a rod bolted to a block which clamps to the back V of a lathe, and which can be clamped or unclamped to permit the shifting of the device from the operator's position at the front of the lathe. With the taper attachment all kinds of chuck and face plate work can be done that are usually accomplished on the ordinary lathe, but with greatly increased production. The proportions of the lathe are ample, the front bearing being 2¾" diameter by 4½" long, ratio of back gearing, 12 to 1, diameters of cone 4½ to 12 inches for 2½" belt.

* * *

The following are said to be the rules of conduct adopted by Dr. Robert H. Thurston for students of engineering at Sibley College, Cornell University.

Rules Governing Students in Sibley College, Cornell University.—Formulated under the statutes of the University, which provide that the director shall control the "whole working" of Sibley College:

(1) Every student in Sibley College is expected to show himself a gentleman at all times, within or without the precincts of the college.*

(2) Every gentleman attending Sibley College is expected to be a student.

College students are not always as orderly as they should be, but it is undoubtedly a fact that this code of conduct works more successfully with them than a whole list of rules and regulations and a demerit check system thrown in. They are at least intelligent men and should be accredited with a sense of honor and a desire to do the right thing.

* Gentlemen.—A man of good breeding, courtesy and kindness; hence a man distinguished for fine sense of honor, strict regard for his obligations and consideration for the rights and feelings of others.—Century Dictionary.

AMONG THE SHOPS.

NOTES FROM THE C. W. HUNT COMPANY'S WORKS—A SIMPLE ENGINE WITH A NOVEL REVERSING GEAR—METHODS OF MANUFACTURE.

At the last annual meeting of the American Society of Mechanical Engineers the retiring president, Mr. C. W. Hunt, delivered the annual address, choosing as his general theme certain phases of the life and work of the engineer. He called particular attention to the difficulties of the engineer who submits tenders for the construction of machinery for which specifications have been drawn by other engineers.

Whether or not specifications are actually drawn there are always certain conditions to be met and certain requirements to be fulfilled, and it is a fact, attested by the experience of every constructing engineer, that his difficulty is not so much in designing this or that particular device as in determining what the conditions and requirements are and in deciding what is necessary to answer these demands.

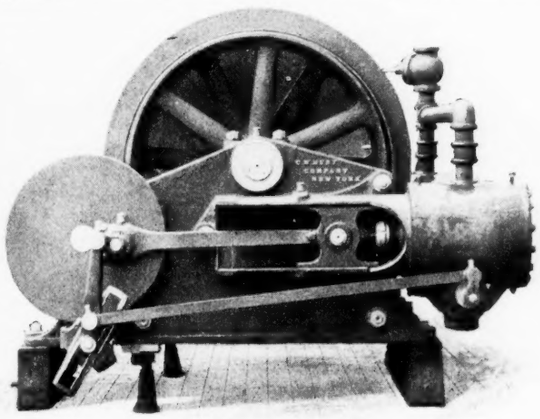


FIG. 1. ENGINE WITH HACKWORTH RADIAL GEAR.

Mr. C. W. Hunt is at the head of the well-known C. W. Hunt Co., of Staten Island, N. Y., who manufacture industrial railways, coal handling machinery, conveyors, hoisting engines and similar machinery, and it is possible that his address reflected some of his own experiences during the last quarter of a century in the development of his business. It may at least be said that machinery of the class mentioned has to conform to rigid requirements in actual use, if not in written specification, that are peculiarly trying.

It must be proof against dust and dirt and incompetent help; and it must be simple in its adjustments. The engines, especially when used for hoisting, must thrive under exposure in all kinds of weather, including zero temperature, when there is usually trouble from ice in cylinders and pipes. This machinery, also must often be installed in cramped quarters, and in buildings not originally designed for it.

A mechanic who calls at the works of the C. W. Hunt Co. will find much about the plant to interest him, a conspicuous part of which is a large building of modern design in which the sheet metal and structural work is done. The punches, shears, riveters, etc., are driven by independent electric motors and afford a good object lesson of what is to be gained by this arrangement. An example of the work done here are metal ties, for the industrial railways, which are pressed into shape at one operation from heavy sheet metal.

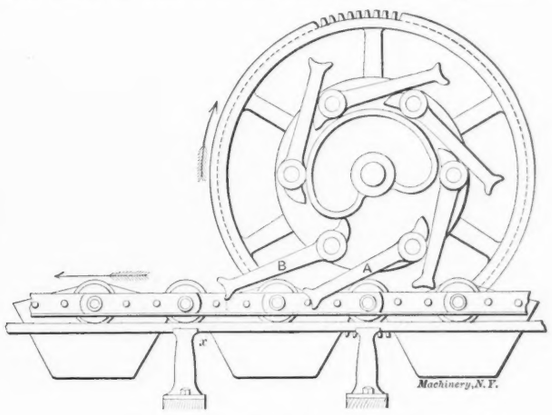


FIG. 3. DETAIL OF DRIVING GEAR.

Of greater novelty, however, are some of the products of the shops, since the machinery turned out is quite different from that seen by most mechanics in the routine of their daily duties. It would not be natural to visit a coal wharf or storage shed to find anything of mechanical interest, and yet the engines and machinery designed for hoisting coal and for conveying it in gravity conveyors have features so original that we shall call attention to a few of them. In Fig. 1 is shown one of the hoisting engines and in Fig. 2 is a reproduction from a photograph showing the mechanism for driving a conveyor, the power in this case being from an electric motor instead of from a steam engine. The conveyors consist of a pair of endless chains between which are a series of buckets, each of which is hung on pivots and kept in an upright position by gravity. The chain is carried by wheels which run on tracks. The buckets are filled and dumped at the desired points and the material may be carried any desired dis-

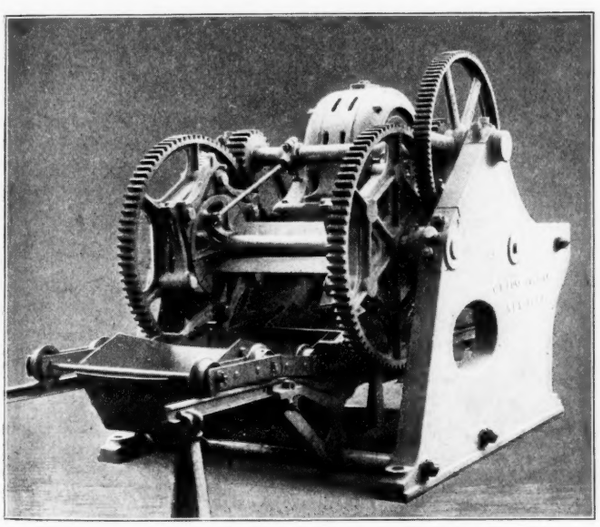


FIG. 2. CONVEYOR DRIVER

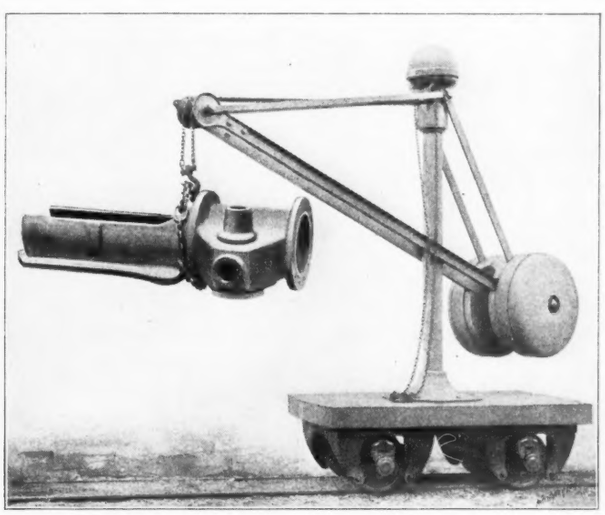


FIG. 4. SHOWING DETAILS OF ENGINE FRAME AND CYLINDER.

tance and in any direction, horizontal, vertical or slanting. The chain and buckets are propelled by a system of rotating pawls, as shown in principle in Fig. 3. Each pawl in turn engages one of the pins of the chain and after having pushed it ahead the pawl is raised by the cam and the next pawl repeats the operation. It will be noted that as pawl A reaches the lowest point of its travel it is increasing in speed in a horizontal direction and the conveyor is moving with it, while pawl B, having passed the lowest point, is gradually decreasing in speed and falls behind the conveyor by an amount indicated by x, thus giving ample opportunity for the withdrawal of this pawl without interference.

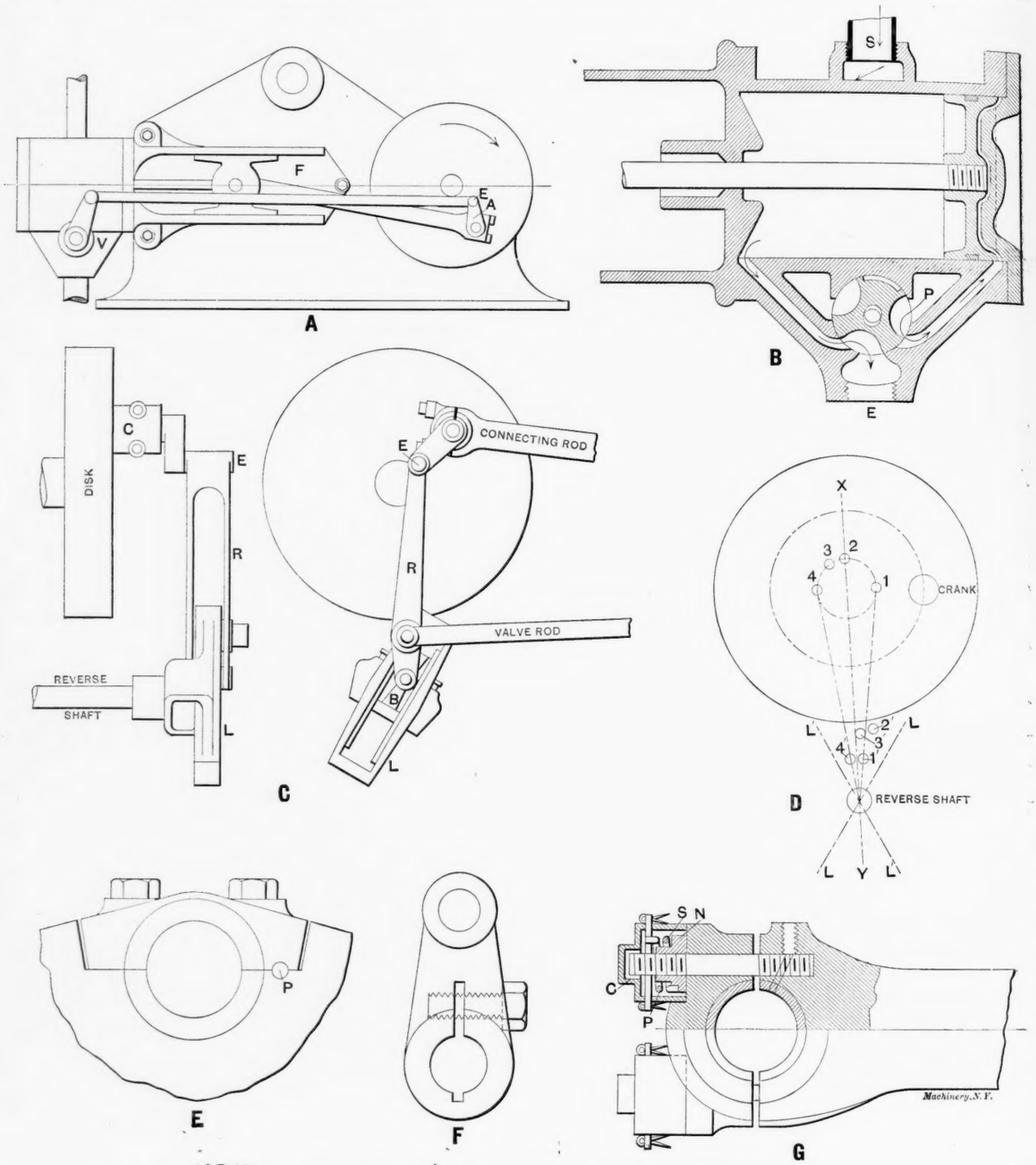


FIG. 5. A COLLECTION OF ENGINE DETAILS THAT ARE ORIGINAL AND NOVEL.

Engine Details.

In Fig. 5 are shown a number of details of construction of the engine which is used for hoisting and for driving the conveyors. Most of these are patented, but are none the less interesting. The engraving is made from rough sketches which do not represent either the proportions or details accurately, the idea being simply to show the general arrangement.

At A is the engine in outline. In view of the conditions under which this machine must work, as previously mentioned, the essential features to be provided for in its design are extreme simplicity, both in the mechanism and the adjustments, accessability, complete oiling arrangements and freedom from freezing when the engine is shut down in cold weather.

The frame of the engine, F, and the cylinder are in one casting. The guides are bored and the valve of the engine, V, is a plain slide valve, but is cylindrical in form and oscillates on a cylindrical seat. Being placed under the cylinder, all water of condensation drains into the exhaust pipe, and if an unusual amount of water comes over from the boiler, the valve will lift from its seat. This form of valve is said to remain tight for years. Instead of an eccentric to operate the valve, a lever, A, is attached rigidly to the crank pin, its other end, E, being so located as to give the right radius of throw for operating the valve-rod. This construction places the valve gear entirely outside, in the open, where it is under the direct observation of the engineer and there are no eccentrics to become coated with dirt and grease and so give trouble.

At B is a section of the cylinder and valve. Steam enters at the top at S, passes around the cylinder, through the space, P, and thence in the direction of the arrows into the cylinder. The exhaust passes out, as shown at E.

When the engine is to be used for hoisting it must be built to reverse and the Hackworth radial gear is used for this purpose. While this type of gear is frequently used in marine practice and was originated many years ago, it is probably new to many who have had to do mainly with stationary engine practice. The extreme simplicity of the gear will be evident from the sketch at C and the photograph in Fig. 1. Its parts are fewer than those of the Stephenson link motion, and the results accomplished by it are all that could be expected. Referring to the sketch, in which a front and side view is shown, motion is taken from the pin at E as in the case of the engine shown in Fig. A. R is the eccentric rod and at its lower end it is pivoted to and supports the block B, which slides in the link L. The eccentric-rod is made double, or forked shape, to properly support the block. The link is carried by a yoke which is attached to the reverse shaft, as indicated. When the link is inclined in one direction the engine will run over and when it is inclined in the other direction the engine will run under. The conection with the valve is by the valve-rod which obtains its motion from the eccentric-rod R.

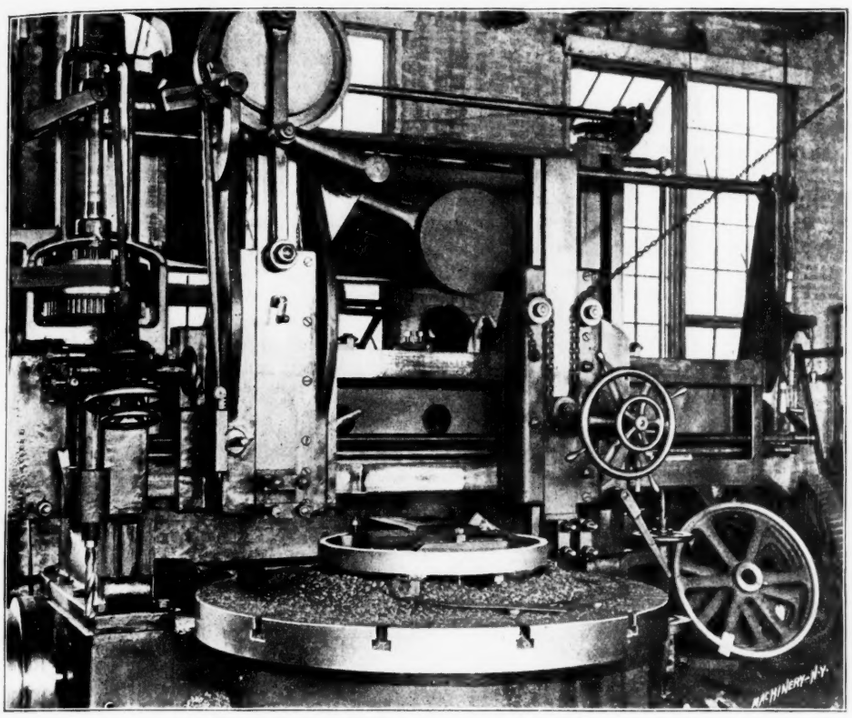


FIG. 6. A COMBINED BORING MILL, SLOTTER AND DRILL.

In operation the upper end of the rod R follows the path of a circle, while the lower end slides in a straight line, guided in direction by the inclination of the link. A feature of the motion is that it gives constant lead for all points of cut-off and this lead is the same at both ends of the cylinder. The diagram at D will illustrate this point as well as show in a general way the relative motion of the parts.

Points 1, 2, 3 and 4 indicate positions of the pin E, which corresponds to the eccentric in an ordinary engine. The reverse shaft is at the point indicated and two positions of the link are at L, L, and at L′, L′. In this gear, when the valve is connected directly, without the intervention of a rocker, the eccentric is placed exactly 180° ahead of the crank, or directly opposite to it. In this engine, however, the lever on the valve is equivalent to a rocker and the eccentric is therefore placed in line with the crank. Hence, when the crank is on a center, as indicated in the sketch, points 1 and 4 will be the positions of the eccentric corresponding and they will be the positions at which the valve will be open an amount equal to the lead. The reverse shaft is so located that in these two lead positions the block which slides in the link will be directly at the center of the shaft and its relative position will be the same at whatever angle the link is inclined. Points 1′ and 4′ show the amount of movement of the valve-rod each side of the center line when the valve is open an amount equal to its lead. With the link inclined as at L, L, point 2′ is the position of the end of the valve-rod for the extreme upper position of the eccentric. Between points 1 and 2 the effect of the eccentric is to make the valve-rod move to the left, but this effect is overbalanced by the effect of the link, which is to make the rod move to the right, and this effect will be greater or less, according to the position in which the link is placed. Point 3′ is about the position for cut-off and from thence the rod passes the center line, and its action is duplicated in the opposite direction. This form of gear does not give equal cut-offs for both ends of the cylinder, nor equal port openings; but by a suitable arrangement of the levers this can be approximated.

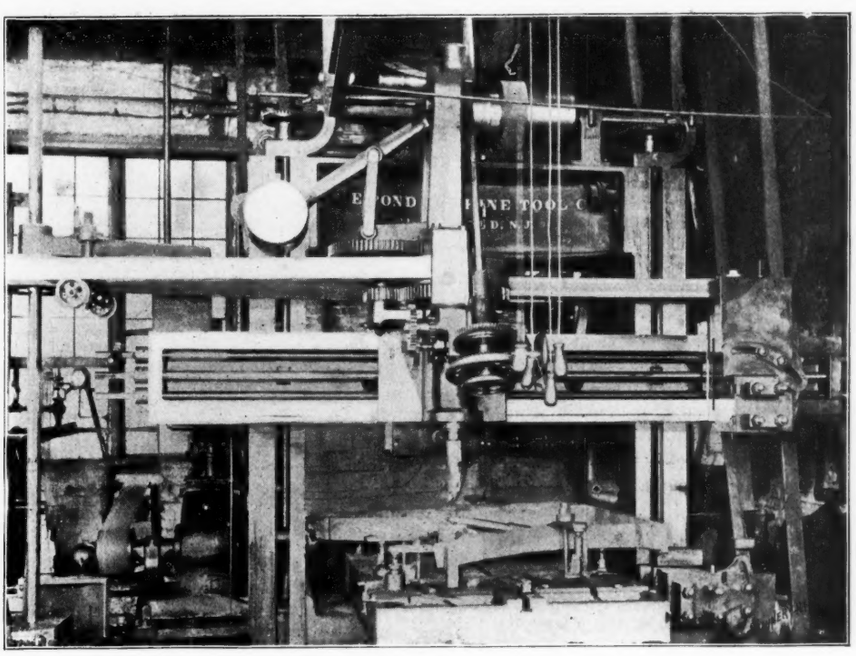


FIG 7. A PLANER WITH DRILLING AND BORING ATTACHMENT.

Other Details.

It was stated that a desirable feature for engines of this class was simplicity of adjustments. It would indeed be well if the necessity for adjustments could be eliminated altogether, but

this, of course, is not feasible. The cross-head has no adjustments for wear, dependence being placed on generous bearing surfaces and through oiling. To ensure the latter the cross-head is made long enough so that it never uncovers a central oil well at the center of the guides. This well is filled with an absorbant packing, which keeps the surfaces well lubricated and at the same time is protected from dust. Other bearings are lined, either with phosphor bronze or hard babbitt, so that they need be adjusted only at infrequent intervals, but in bearings like that of the crank-pin, where any looseness means a pound, the adjustment must be more frequent and unless it is intelligently done there is danger of heating.

In Fig. G is shown how this adjustment is effected in the Hunt engine. The connecting-rod has a plain marine end, with studs, one of which is shown for holding the cap. A nut, N, is screwed onto the end of the stud, to which is attached a coiled spring, S. A hole is drilled through the stud, near its end, for the pin P and after the cap P, which is intended simply to protect the parts, is in place, the pin is slipped through one side of the cap, and by a turn the spring, which bears against the pin, is coiled, and the pin is then slipped through the stud and the other side of the cap. This makes an automatic adjustment which is said to give good satisfaction. When slack occurs in the bearing the friction against the nut is reduced to a point where the tension of the spring is sufficient to give the nut a fraction of a turn.

At E and F are two interesting details that are worthy of attention. The first is a bearing seen on a frame for one of the hoisting drums. It can readily be appreciated that there are decided objections, aside from that of cost, in employing ream bolts and nicely planed fits for the caps of bearings exposed to the weather and to dirt and grit. It is important, however, to have the cap and the lower half of the bearing align, and the simple expedient is used in this bearing of drilling and tapping at P for a threaded stud or pin. This pin effectually prevents the cap from moving in any direction, after it is bolted down.

The lever at F is interesting because it overcomes a difficulty that is continually met with in engine work. The most secure method of holding a lever on a shaft is by a key, but if the key is to remain tight, the lever itself must first be a tight fit on the shaft. Any looseness is sure to loosen the key. A hole may be reamed to size and a shaft ground to fit it, but if the gear has to be taken apart and assembled many times the fit will no longer be a fit unless it was originally made so tight that it is troublesome to take apart. The slot and capscrew shown in the sketch make it possible to keep the lever tight on the shaft.

Machining Work at One Setting.

In connection with the foregoing description of some of the machinery to be seen at the works of the C. W. Hunt Co. it will be interesting to call attention to some of the shop methods in vogue there, which, while contrary to the practice of most shops, are believed by Mr. Hunt to effect a considerable saving and also to produce superior results.

Most mechanics are opposed, from principle, to combination tools or machines. In Figs. 6 and 7, however, are photographs of two expensive machines at the Hunt shops which are combination tools in every sense of the word. One is a boring mill to the cross-rail of which is added a slotter head and a radial drill head to be used either for drilling or boring. The other is a planer with a drilling attachment. These machines were built to order and the fact that such expensive special machines should be in use shows the attention that is being given to the machine work.

It would be natural to ask what the class of work is that requires machines of this character and what is gained by their use. We are unable to quote figures in answer to the latter question, but both questions can be answered in a general way by reference to a few of the pieces that have to be machined.

On the planer, connecting-rods are planed on each side on centers and then are bored without disturbing the setting. The side frames for the hoisting engines and for the conveyor driver are planed and the several holes drilled at one setting. One of these frames is shown in Fig. 2 and where the steam instead of the electric drive is used there are still more holes to be drilled than shown in the illustration. Templates are used for these frames and in fact templates and jigs are employed throughout on most of the work. Another typical piece is the engine frame, which is clearly represented in Fig. 4. This is planed and drilled, and the seat for the valve is bored at one setting. The casting is then taken to a horizontal boring machine where the cylinder is bored and faced, the guides are bored and the bolt holes are drilled by this one machine.

On the boring mill gear blanks are turned, bored and key-ways slotted at one setting and pieces like the gear which carries the pawls in Figs. 2 and 3 are turned and the holes drilled on the same machine.

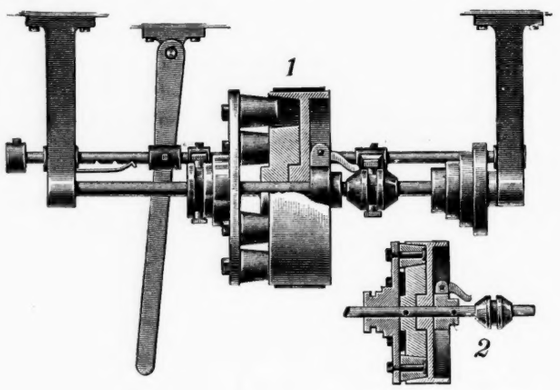
It is a conservative estimate to say that the time required to set up the average run of work is 50 per cent.of the time required to do the actual cutting. This being the case, Mr. Hunt holds that it pays to save as large a slice of this time as possible, even at the cost of the interest on two expensive machines. Aside, however, from the question of cost, there is no doubt that better work can be done quicker and easier by having the various operations performed at one setting. The holes will line better with the planed surfaces.

While not in the line of combination machines, another operation seen at the works is worth noting. In making the pistons and cross-heads for the engines, these two parts are fastened securely to the piston rods and turned down to nearly the correct size. They are then put on centers on the universal grinder and both piston and cross-head ground to the size called for. This ensures perfect alignment, superior surfaces and exact sizes.

* * *

REVERSING MECHANISM FOR MACHINE TOOLS.

The cuts Figs. 1 and 2 show the essential features of a reversing device to take the place of the familiar open and crossed belt arrangement so generally used on lathes and other tools that require a reversal of movement. Fig. 1 is a view of the reversing mechanism with parts in section; Fig. 2 is a section showing the operative parts in a position different from that illustrated in Fig. 1.



Upon the power shaft a disk is rigidly secured, which is provided with a conical periphery. Loosely mounted on the shaft is a pulley having an interior conical flange. By means of a clutch of any desired form, the pulley can be locked to the shaft, so that the motion of the pulley is communicated to the shaft. A second disk loosely supported on the shaft is provided with a series of rollers in a circle which can be shifted into engagement with the periphery of the first mentioned disk and the internal surface of the conical flange of the belt pulley. The clutch and the roller disk are so connected by a movable rod that they may be simultaneously operated by a shifting lever.

When it is desired to turn the shaft and the belt pulley in one direction, the shifting lever is swung to the left, thus causing the clutch to bind the pulley to the shaft. When it is desired to reverse the motion of the shaft, the operator, by means of the lever, shifts the movable rod to the right, and thus changes the positions of the clutch and roller disk from those shown in Fig. 1 to those shown in Fig. 2. The clutch is thereby made to disconnect the pulley from the shaft; and the roller disk is reciprocated so as to throw the rollers into engagement with the pulley flange and the first mentioned disc.

This invention was recently patented by E. E. Norton, of Bridgeport, Conn., and illustrated in the Scientific American.

STEP BEARINGS

OF SIMPLE CONSTRUCTION FOR LIGHT DUTY.

In the November, 1898, number of MACHINERY Prof. C. H. Benjamin showed several forms of ball step bearings that have been used successfully. It sometimes happens, however, that one wishes to use a bearing of simpler or cheaper construction where the speed is slow or the thrust is light so that the duty required of the bearing is not severe.

A number of practical suggestions for bearings of this kind are contained in the second volume of Prof. Jones' Machine Design, which was noticed in the May number of this paper. From the chapter upon bearings we make the abstract which follows*, to which is added a description of the bearing used by the Rice and Sargent Engine Co., Providence, R. I., for supporting the governor spindles used on their engines. In speaking of the wear of simple step bearings like that of Fig. 1, Prof. Jones says:

"When the shaft in Fig. 1 makes one revolution, the parts on the end farthest from the center rub over the box through a

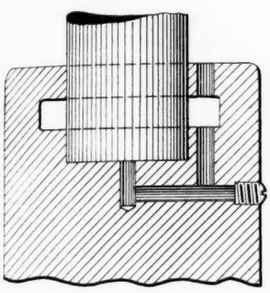


FIG. 1.

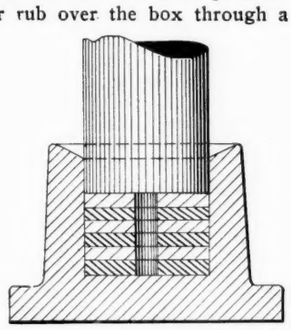


FIG. 2.

distance equal to the circumference of the shaft, while those near the center rub over a much smaller distance, and the geometrically central point does not have any motion over the box. On account of this inequality of rubbing there will be a corresponding unevenness of wear, so that if the parts are fitted together accurately when new, so as to make the pressure uniform over the end of the shaft, the outer portion will wear away most rapidly in service, thus causing the pressure to become heaviest at the center, and lightest at the outer part of the rubbing surfaces. The pressure at the center may become so intense as to crush the material at that point. Even if this does not occur, abrasion and cutting are likely to take place. The inequality of wear and pressure may be partly obviated by removing some of the material at the center of the rubbing parts, leaving a pair of annular rings for the rubbing surfaces. This is advisable in nearly all cases."

"If the speed of the shaft is high, difficulty will be experienced in lubricating it on account of the centrifugal action of the rotating part throwing the oil from the center and not allowing it to return again, unless some special provision is made for its doing so. Such provision can be readily made, however, as shown in Fig. 1, by making an oil-passage from the top of the step to the center of the bottom of the bearing. This arrangement forms a small centrifugal pump, which draws the oil in at the bottom of the bearing through the oil-passage, throws it to the outer part of the bore, and forces it to the groove around the top of the step, so that it will again be ready to start on the same circuit. Complete and free circulation may thus be secured.

"For heavier duty, either on account of increased speed or pressure, this form of bearing may be made more durable by placing a number of disk-shaped washers between the end of the shaft and the box, as shown in Fig. 2. One set of these washers is generally made of some hard material, such as steel, and the other set of a softer material, as brass or bronze. The two kinds are then placed alternately, so that each washer rubs against a material different from itself. If the shaft is of mild steel and the box of cast-iron, which is a common construction, the top washer is often fastened to the shaft, and the bottom one to the box, thus making all of the wear come upon the washers. The number of pairs of bearing surfaces over which the wear is distributed is one more than the number of free washers. The series of washers permits a slower speed of rubbing between each pair of the surfaces, and, in case abrasion should begin between any pair, the rubbing motion will cease there until the oil has an opportunity to get between them, or until repair can be made, without serious injury to the machine or the necessity of stopping it. The washers generally have a hole bored through the center, and are grooved radially for oil. The same device for securing circulation of the oil, as is shown in Fig. 1, can be used, of course. Hardened and ground tool steel, or case hardened and ground mild-steel washers running on brass or bronze give most excellent service."

"In machinery where the shaft and box cannot be accurately aligned, or where they may get from out of line from some cause, such as settling of the supporting parts or springing of the shaft, lenticular washers with spherical faces of the form shown in Fig. 3 may be used. By making them smaller in diameter than the bore of the box, they will adjust themselves to a perfect bearing for any relative position of the shaft and box, within the limits for which they are designed. As with the flat washers, however, the wear will be more rapid at the parts more remote from the center."

The Rice and Sargent bearing is shown in Fig. 4. It is a well-established principle that it is better to take the thrust of a bearing as near the center of the shaft as the load to be carried will allow. The farther away from the center the support is, the greater is the motion and the greater is the retarding effect of the friction. The thin convex washers used are of tool steel, hardened, and although the bearing between them is very small, their strength and hardness is such that they are capable of standing a considerable pressure, though not as great a one, probably, as the other forms shown by Prof. Jones. In this bearing, also, there is no difficulty in keeping the surfaces well oiled, since all that is necessary is to keep the chamber well flooded with oil.

Since the foregoing was written Professor Jones has called our attention to tests on the relative efficiences of a button bearing, similar in principle to that described above, and a roller bearing. The tests were made by Dr. Thurston on some worm-gearing for the Yale and Towne Manufacturng Co., the thrust bearings being employed for taking the thrust of the worm. In this case, however, no disks were used in the button bearing, this

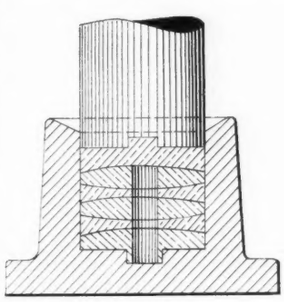


FIG. 3.

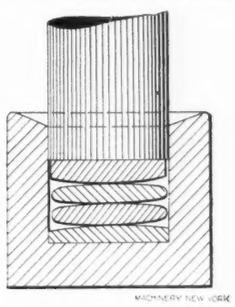


FIG. 4.

bearing consisting simply of a convex piece of hardened steel on the end of the shaft, which bore against the hardened end of a set-screw. The per cent. efficiency of the worm gearing increased from six to forty-nine as the horse-power per 100 revolutions of the worm per minute increased from .25 to 6. During the same range of power the efficiency of the gearing with the roller bearing increased from nine to fifty; but at this point, when six horse-power was being transmitted, the efficiency of the button bearing became higher than that of the roller bearing and at eight horse-power the two efficiencies were fifty-nine and fifty-four, respectively.

* * *

An interesting product is a blow-hole cement, which C. H. Besley & Co., Chicago, Ill., have lately put on the market. While not advocating the practice of attempting to cover up defects in castings, it must be admitted that there are many places where the use of some durable filler would be entirely legitimate. We are informed that this cement stands 200° temperature, is gas and air-tight and can be worked with a knife. It is also said to stand well under the planer or lathe tool and the file.

* By permission of the author.

ARTISTIC BLACKSMITHING.

H. W. SARGENT.

A blacksmith's trade is, more than many others, dependent upon the skill of the hand and accuracy of the eye, rather than upon the mechanical judgment and knowledge of the machinist. The present century has witnessed so remarkable an advance in mechanical and scientific development that the lesser arts of handicraft have been crowded to the wall. Of late years a revival in handiwork has made itself felt, largely through the influence of technical and manual training schools, resulting in an exhibition which has just been held in Boston, called the Arts and Crafts Exhibition. It is the purpose of this society to bring together the designer and the workmen and to interest the public in the delightful qualities of handicraft.

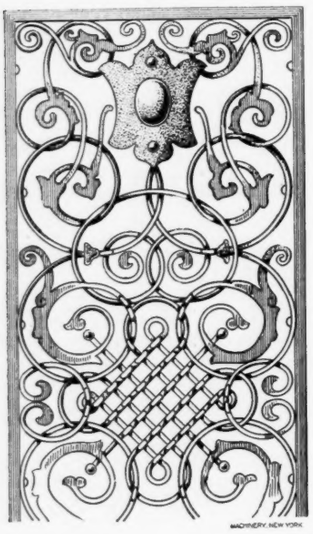


FIG. 1.

FIG. 2.

To the readers of this journal the most interesting feature of the exhibit would perhaps be the wrought iron work; in fact many would be surprised at the possibilities of the anvil. Some of the pieces were extremely difficult and complicated in the way of interlacing, welding and decoration. In Fig. 1 is shown a portion of an iron grill, the scrolls being formed out of round iron beaten out on the anvil into foliated curves. Wherever two bars crossed, one was punched with a drift tool and the other passed through. This exhibit was shown as it was left by the hammer, without paint or any finish With all our modern appliances for rapidly and easily working iron we see no way of accomplishing such work as that shown in Fig. 2, except by hand with the factor of time omitted.

Machinery has, however, greatly aided production of such work as casting, which is found in railings and elevator cars, where ornamental effects are desired, but where great cost prevents the employment of hand work. Where a large series of the same pattern is wanted it is possible to rig up machinery and machine tools to execute this work quickly and cheaply. Dies for punching and cutting off iron, jigs and templates for drilling and formers for bending up scrolls are the contributions of the machine shop which lessen the amount of slow and costly hand work. The bronze transom, shown in Fig. 3, shows evidence of such mechanical assistance. Architects and engineers who persist in overlooking these features fail to understand why their own seemingly simple designs cost so much more than others more complicated and apparently more expensive.

Much elaborate and beautiful work was produced when time and human labor were cheap as during the sixteenth century. The blacksmith of those days was a serf, almost a slave to his lord, the baron. His whole time was his master's, and he often spent weeks on a sword hilt or months on a set of hinge plates for the castle door. This was in the olden time and across the ocean, but to-day, in this country, we have reached the point where we are able and willing to pay the additional cost of beautiful and thorough work. Much of this is paid for by corporations or business firms, which is not to be regretted, since more people have the opportunity to see it than if it were hid away in some private house. The silver grill, shown in Fig. 4, will attract the attention of all customers who visit the bank of Buffalo.

Among the many notable examples of iron work shown, some were designed by prominent architects and worked out under their direction, but the best results, the highest qualities in handicraft, are had when the workman is himself the designer. In many manufactories it is not expected that the designer will follow or take part in the execution of his own designs. It is thought to be a waste of time, neither is it expected that a work-

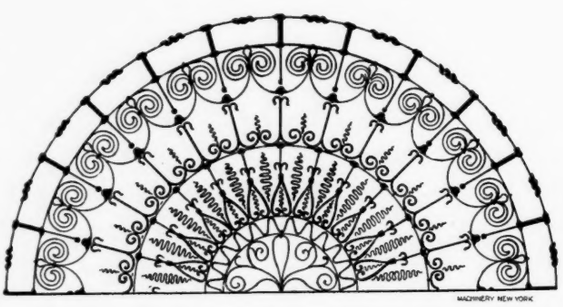


FIG. 3.

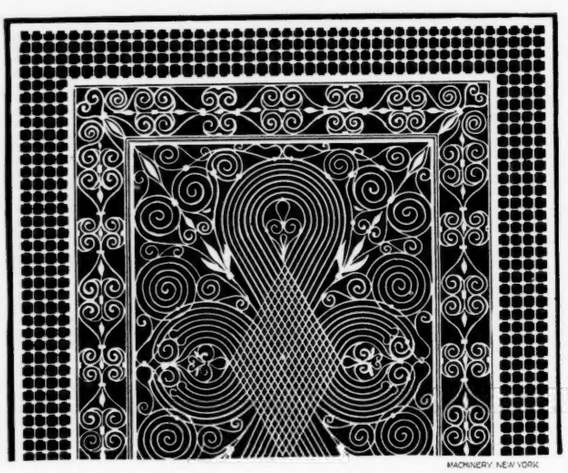


FIG. 4.

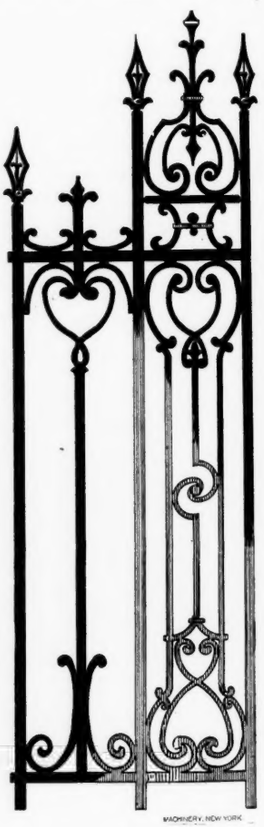


FIG. 5.

man, least of all a blacksmith, should be consulted or concerned in the production of a design. The manual training schools take a different view of the subject; they endeavor to effect a closer relation between the brain and the hand, to educate the designer to follow what is best in form, outline and decoration and to show the workman how to bring out the greatest possibilities in the design.

The revival of public interest in such work has seemed to justify such exhibitions as the present. We may learn several "lessons" as the preacher would say. We see the broadening effect of education even on so humble a trade as blacksmithing, and education, too, on so unrelated a subject as designing. We learn, moreover, that the artist is not alone he who has learned to "sling paint," but that a man may be truly an artist with a hammer, and that the worker who excels in any department of art is an artist.

* * *

ADJUSTABLE HOLLOW MILL.

The adjustable hollow mill, shown in Fig. 1 herewith, is designed for use on turret lathes and screw machines. Details are shown in Fig. 2, which is from a photograph of the tool with the casing removed. The tool is made of bar steel and consists of only three parts aside from the cutters and screws. These parts are the holder, or body of the tool, the cam which is seen at the left, and the ring or collar, which is seen on the shank of the holder at the right. The cutters are made with small lugs which fit in slots milled in the inner side of the cam

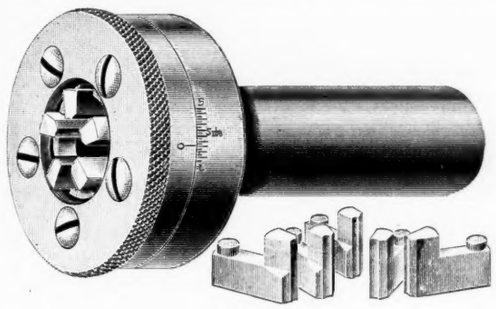


FIG. 1.

plate. The cutters fit in the radial slots of the holder and as the cam is moved one way or the other the cutters consequently travel in or out in a radial direction. One of the cutters is shown in the position which it occupies relative to the cam plate.

The screws pass from the cam through the holder to the ring and serve to fasten all the parts firmly together. The cam and holder are graduated, as shown in Fig. 1, to read to hundredths of an inch to assist in setting the cutters to the correct diameter and the edge of the cam plate is knurled around its periphery to facilitate adjustment.

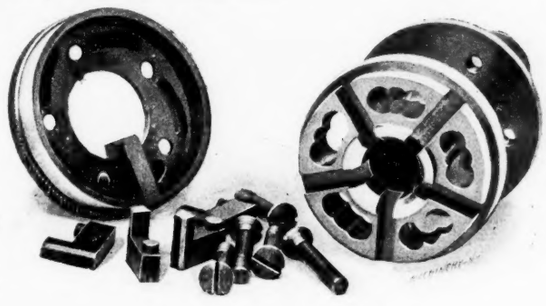


FIG. 2

Those who have had experience with the common type of spring milling tool, which will mill only one diameter and can be adjusted only within narrow limits and then with difficulty, will appreciate this improved form of tool. A quick and easy way of setting the cutters is to use hardened steel sizing plugs with which the cutters are brought in contact by turning the cam and they can then be fastened in position without reference to the index. These tools are made in three regular sizes, which take work from ⅛ to 1¼ inches in diameter by the Geometric Drill Co., Westville, Conn.

FAMILIAR SUBJECTS IN MECHANICS.—3.

SHAFTING (Continued.)

SAMUEL WEBBER.

In my previous article on Shafting, I promised to say something more about steel shafting, and the first thing to note is, that since the discovery of the Bessemer and Open-hearth processes, steel has almost entirely superseded iron as a material for shafts, and the formula given by Mr. Francis, which I have quoted before, may be safely relied upon to give ample strength for all purposes of power transmission.

Although these formulas were based on steel made in the old-fashioned way, by "cementation," which might be supposed to be stiffer and more elastic than the mild steel produced by the new processes, the operation of "cold rolling," which is largely in use, has given the shafts prepared in that way a strength and elasticity which render the formulas entirely safe. The only position in which they cannot be relied upon is in the case of first lengths, or "head-shafts," where, as I have previously stated, the point to be looked at is the resistance to flexure and not to torsional strain. In this I am sustained by Messrs. Jones and Laughlins, very large producers of this cold rolled steel, to whom I wrote recently, asking if there was any later information on the subject of shafting which I could use to advantage. In their reply they first mention this very point, saying "that for head-shafts they would usually advise that no lighter or smaller sizes should be used of steel than of iron, because the steel will really depart from the right line about as easily and quickly as iron under the same load."

They also inform me that they now "cold-roll" steel shafts up to 5" diameter, which, in many cases is large enough for head-shafts, and would be ample to transmit 250 horse-power at 100 R. P. M., and unless the main pulleys were exceptionally heavy, would resist the transverse strain for the same power.

Another inquiry made of them was in regard to a statement I had heard made, namely, that cold rolled shafts would spring when spliced, or key-seated; to which they reply that all shafts will do so, more or less, under the same conditions, and that they always take care to straighten all shafts of their manufacture after key-seating, before they are sent from their shops, and that they have found large forged shafts of 20 inches diameter to spring after key-seating.

Mr. Briggs, of Jones & Laughlins, recalls an old story of Mr. Francis, who is reported to have answered, when asked for a formula for shafting, "calculate as close as you can, and then use your best judgment!" Mr. Burke, of the Lowell Machine Shop, used to tell a similar story about an old-school millwright, whose rule for belting was the same, except that instead of previous calculation, his first step was "to guess and allow," after which he called in "his best judgment!"

Speaking of key-seating naturally suggests another mode of holding pulleys fast on the shaft, which is coming into extensive use in the case of "split pulleys," and that is the substitution for a key of a wood bushing or tube which is compressed on the shaft in the act of clamping the pulley together. If the shaft is at all rough, this is highly effectual. This was introduced by the Dodge Manufacturing Co. to whom I have already referred in the case of "chain oilers."

As these bushings are bored to fit all sizes of shafts, while of the same exterior diameter according to the size of pulley, it is a very simple matter to change a pulley from one size of shaft to another of different diameter.

These wood bushings have been highly recommended by a committee of the Franklin Institute, and have, so far as I know, given entire satisfaction in practice. There is no doubt that many shafts are sprung by the injudicious use of "set-screws," and it is to that cause that I attribute the springing of a long shaft in the centre, at the pulley, noted in my last letter. Here also the "clamped bushing" is an easy remedy. Returning to Mr. Brigg's letter and his quotation from Mr. Francis, he speaks of a case in which the use of judgment is required as well as the information derived from calculations, and that is, in fitting up the shafting for a cotton or woolen mill.

While in the carding and spinning rooms the motion is continuous, and rotary, and the size of shaft can be easily calculated by formulas, the motion in a weaving room is reciproca-

tory, and the size of shaft necessary to drive the looms steadily is much larger than would be necessary to simply convey the power. Although the power required in a weaving room would not be one-quarter that needed for spinning, it would call for a shaft of half the strength. It was here that some of the advocates of very light shafting. came to grief thirty years ago, and had to put "fly-wheels" on to their weaving room shafts to keep the looms running at the farther end of the room. There are other mechanical operations in which reciprocatory motion must be provided for, and the shaft must always be of sufficient diameter to bear the heaviest of the different strains imposed upon it, but I speak of the spinning and weaving rooms of a cotton mill, as being especially clear and prominent instances where judgment is required. We may now return to the subject of pulleys. While the cast-iron pulley in common use on all machines and on the shafting for driving, is undoubtedly the cheapest and the most generally applicable of any pulley that has ever been devised, there are cases in which something different is preferable. It is a well known fact that the driving power of a wooden-faced pulley is greater, as the coefficient of friction is larger than on an iron face, and the belt holds more tightly to the surface, and in many cases where the pulleys required are over three feet in diameter, there is a tendency to return to the wooden-faced pulley; I say return, because in my young days, not only were all the large main pulleys built up with wood on iron spiders, but many wooden drums were used for driving machines where we now use cast-iron pulleys. When I first went to Lowell in 1841, all the looms in the Meminach Mills were driven in that way. A square cast-iron shaft, 8 feet long, reached from beam to beam, having a coupling on one end and a bearing turned on the other, as I remember, and these, when coupled together, made a continuous line the length of the room. To each length of shaft were

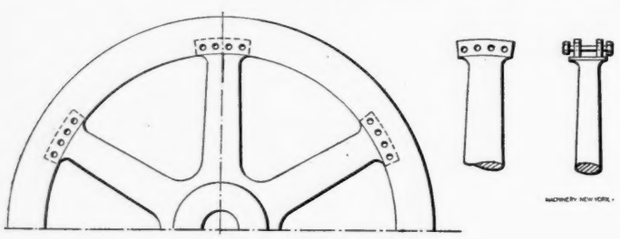


FIG. I.

fitted two wooden heads, of the proper diameter, like the heads of a barrel, and to these were fastened the staves, five or six feet long, which, when turned down true formed the drum which drove four looms. When a belt had to be taken up or tightened, there was a hook in the ceiling over the drum to which the belt was hung by means of a pole with a stud in one end. This kept the belt from lapping up round the drum. There was no chance to drop the belt onto the shaft, as is now done, when it was taken off the loom pulley. I think, however, that wrought-iron shafts and cast-iron pulleys had been then introduced in the newer mills, built from 1836 to 1840. While it is not in any way probable that wood-rimmed pulleys will again be used for any such purposes, or supersede cast-iron for pulleys less than 3 feet in diameter to any extent, it is unquestionable that for larger sizes they are coming into very general use, especially in the form of split-pulleys. These can be readily, and in a very short time put on or taken off a shaft without disturbing the shaft in its bearings, or unfastening the couplings; and by means of the bushings already described, can be so easily transferred from one size of shaft to another, that they are coming into very extensive use, and can be procured in a great variety of forms, from the very light ones made entirely of wood, to quite heavy ones with a wooden rim on an iron hub and spider.

The number of accidents of recent years from the bursting of large cast-iron main pulleys on steam engines, due to the increased speed caused by the slipping of the governor or some other disarrangement, has led to a very large use of these wood-rimmed pulleys on iron spiders for main drivers, both from steam engines and water-wheels. They can be made of any desired weight so as to serve as balance wheels if needed, but at the same time are not so liable to fracture from centrifugal force as cast-iron. One of these large "composite fly-wheel pulleys," 22 feet in diameter, has been used for rope driving at a surface velocity of 5,800 feet per minute for nearly twelve years. At the present time there are several makes of split and solid wood-rimmed pulleys on the market.

A form of composite pulley which I would suggest can be made as shown in Fig. 1. From a shoulder on the arms of the spider project a web of thickness and depth proportioned to the sizes of the pulleys desired, and through holes in this web bolt segments of boiler plate of such width and depths as will be proper, one on each side. Through these segments again bolt the first course of wooden segments on each side, with the proper filling between them, and then attach the outer courses of wood, by screws and glue, to the required width. In this way a very heavy pulley can be made which will not be likely to burst, with a wooden surface for belt adhesion. Enough for the present.

* * *

PIPE FLANGES AND BOLTS.

The paper by A. F. Nagle upon the "Pipe Flanges and Their Bolts," read before the Washington meeting of the American Society of Mechanical Engineers, discussed a number of points on which those who are connected with steam plants are always glad to receive more light.

Mr. Nagle first analyzed the forces at work upon a flange joint and then prepared the tables which are shown herewith in a somewhat abbreviated form. These tables will be valuable for note-book use. To estimate the available power of the bolts to make a tight joint he used as a basis the results of tests upon the lifting power of common rough screw bolts made by James McBride several years ago. These experiments showed that only ten per cent. of the theoretical power of a bolt may be taken as the effective or actual binding power and also that 200 pounds may be taken as the maximum pull that a man will exert momentarily.

TABLE I.

1	2	3	4	5	6	7
Diam. of Bolt.	Threads per inch.	Length of Wrench.	Theoretical Pull of Screw.	Effective Pull.	Bolt can Resist.	Length of Wrench Recommended.
Inches.		Inches.	Pounds.	Pounds.	Pounds.	Inches.
¾	10	10	106,000	10,600	3,020	4
⅞	9	10	95,400	9,540	4,200	5½
1	8	12	105,600	10,560	5,500	7
1⅛	7	12	92,400	9,240	6,940	9½
1¼	7	12	92,400	9,240	8,930	12
1⅜	6	16	109,200	10,920	10,600	16
1½	6	16	199,200	10,920	13,000	18
1⅝	5½	16	100,100	10,010	15,200	24
1¾	5	18	103,000	10,300	17,500	30
1⅞	5	18	103,000	10,300	20,500	36
2	4½	18	92,700	9,270	23,000	42

Using these figures as a basis, and as preliminary to the results which are to follow, Table I. was deduced. In this table column three gives the lengths of wrenches usually employed for the sizes of bolts listed in columns one and two. Column four gives the theoretical pull that would be exerted by the screw, if there were no loss from friction and there were a pull of 200 pounds on the end of a wrench having lengths of handle as in column three. Column five gives the pull that would be exerted if 90 per cent. of the applied force were absorbed by friction, according to the McBride experiments mentioned above. Column six indicates the stress that the bolts of different sizes are capable of withstanding under the assumption that ordinary bolts can safely sustain 10,000 pounds per square inch. It will be seen from this column that while it is possible to strain a ¾-inch bolt with a ten-inch wrench to three times its safe strength, a two-inch bolt would be strained with an eighteen-inch wrench to less than one-half its safe strength. Mr. Nagle, therefore, calculated column seven, showing the lengths of wrenches that would have to be used to produce a uniform stress of 10,000 pounds per square inch for all sizes of bolts, it being assumed that a pull of 200 pounds is exerted at a distance of one and one-half inches from the end of the wrench.

Having established a pressure obtainable by bolts, the author prepared a table, which is reproduced in part in Table II. herewith, showing the application of these results to pipe flange joints. This table is based mainly upon values used by the well-known firms who make the Crane and Chapman valves.

Columns one, two, three and four are the dimensions used by the Chapman Co. for pipe flanges and bolts and are self-explanatory.

Column five gives the pressure per square inch upon the gasket and is found by substracting from the power of the bolts, found in Table I., column six, the steam pressure on the area of the pipe and dividing the result by the net bearing area of the full flange.

TABLE II.

1	2	3	4	5	6	7	8	9
Diameter of Pipe.	Diameter of Flange.	Bolts. Number.	Bolts. Diameter.	Net Pressure on Gasket per 1 Sq. In.	Nagle Recommends. Number.	Nagle Recommends. Diameter.	Net Pressure per sq. in. on Gasket 1-inch Tongue, Nagle B'lts.	Inside Diam. of 1-inch Tongue
Inches.	Inches.		Inches.	Pounds.		Inches.	Pounds.	Inches.
3	9	6	¾	290	6	¾	1,254	3⅜
3½	9	7	¾	347	7	¾	1,150	4
4	10	8	¾	320	8	¾	1,130	4⅜
4½	10½	8	¾	288	8	¾	950	5¼
5	11	9	¾	300	9	¾	975	5¾
6	13	10	⅞	336	10	⅞	1,360	6¼
7	14	12	⅞	350	12	⅞	1,360	7⅞
8	15	12	⅞	300	12	⅞	1,130	8⅞
9	16	13	⅞	283	13	⅞	1,030	9⅞
10	17½	15	⅞	267	12	1	1,110	11
12	20	18	⅞	236	16	1	1,240	13
14	23	18	1	231	18	1	1,100	15
15	23½	18	1	213	20	1	1,130	16
16	25	18	1	168	20	1	950	17
18	27½	24	1	200	24	1	975	19
20	29	24	1⅛	257	24	1⅛	1,160	21
22	31	24	1⅛	191	24	1¼	1,450	23
24	34	24	1¼	222	24	1¼	1,100	25

For example: A six-inch pipe flange has ten ⅞-inch bolts whose combined pressure = 42,000 pounds. Pressure in six-inch pipe at 250 pounds per square inch = 7,075 pounds. Net total pressure on gasket = 42,000 — 7,075 = 34,925 pounds. Net area of flange = 105 square inches. Pressure on gasket per square inch = 34,925 ÷ 105 = 336 pounds.

It will be observed that the pressure upon the gasket is small, going as low as 168 pounds per square inch on a sixteen-inch pipe, and the highest is 347 pounds per square inch on a three and a half-inch pipe. With 250 pounds steam pressure these pressures upon the gasket are small, and it is not surprising that when a slight transverse stress is produced by expanding pipes the joint is opened on one side and leaks begin.

Mr. Nagle advocates the tongue and groove as the best means for reducing the bearing area of the gasket and so increasing the pressure per square inch upon the gasket due to the pressure of the bolts. The groove, he says, also has the merit of protecting the gasket from misplacement or being forced out in part owing to the pressure of the bolts; the gasket is also protected against being blown out if slightly relieved on one side. The disadvantage is that the gasket is not renewable without opening up the space between the pipes several inches, which is not always possible, and it is not easy to remove a length of pipe.

The width of tongues used by the Chapman and Crane valve companies is thought by Mr. Nagle to be too narrow for the safe handling of the gaskets and he assumes, therefore, that one inch width for all sizes of pipes would be a very good width to use. Still retaining the Chapman bolt table, he finds that with the one-inch tongue the pressure per square inch of gasket varies but little from 1,000 pounds for any size of pipe. To secure still more uniform results, however, he proposes the bolt dimensions of columns six and seven. These are not a new set of sizes, but are made up from the standard dimensions used by the Chapman and Crane companies. We have not reproduced any of the Crane table, but it has one peculiar advantage in that the number of bolts in any flange is always divisible by four, so as to permit valves or elbows being placed quartering, while the revised table does not have this advantage. The latter, however, shows what is desirable for bolts and gaskets and the designer can come as near to fulfilling these conditions as circumstances will permit.

In column eight are the pressures per square inch that would be obtained on the gasket with a one-inch tongue when the bolts are arranged according to Nagle's recommendations. In column nine are the inside diameters for the one-inch tongues.

* * *

The steamship Vulcan, the repair ship of the U. S. Navy, is offered for sale for $100,000. She is low between decks and is not entirely suited to the navy.

A SIMPLE GEAR CUTTER DEVICE.

The accompanying illustration shows the latest style of automatic gear-cutter made by F. H. Bultman & Co., Cleveland, O. The entire machine has been remodeled and the proportions of the various parts have been made ample for the work which this class of machine has to do. One of the improvements is a simple device, shown in Fig. 2, to enable the operator to inspect the blank which is being cut without dropping out the worm from contact with the dividing worm gear, as is usually done.

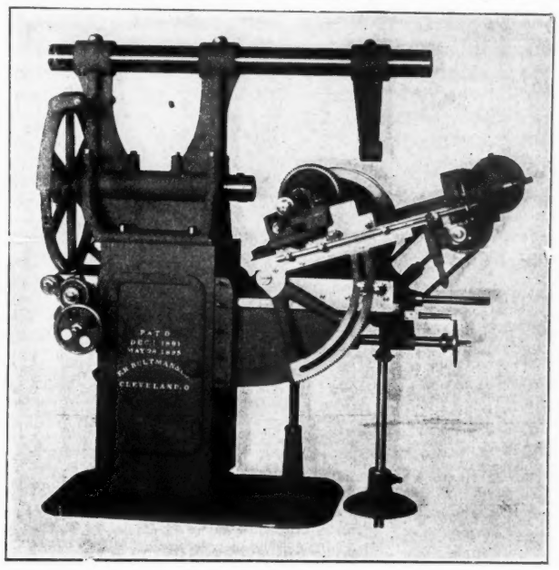


FIG. 1.

In Fig. 2 the dividing wheel W is loose on the work-shaft, but is held securely in place by the dowel pin P. When it is desired to inspect the work, the dowel pin is driven out by a light tap of the hammer and the gear blank G can then be revolved by hand without disturbing the contact of the worm and the worm dividing wheel, upon the accuracy of which depends the accuracy of the gear to be cut. After having inspected his work the operator has only to turn his blank back until the cutter comes about into line with the last cut, when the insertion of the dowel pin will bring the wheel accurately to its position. This feature is clearly shown in the side and rear views of Fig. 2. The manufacturers inform us that other features of value have been introduced in this machine concerning which they will be pleased to give information upon application.

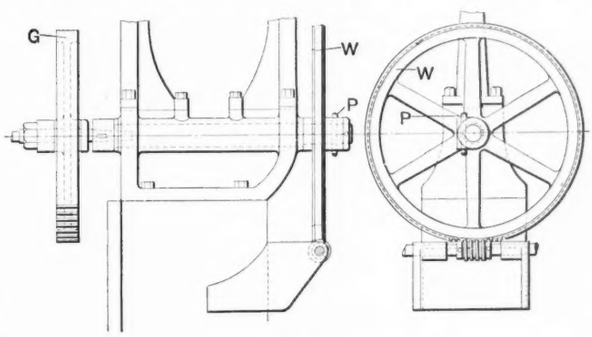


FIG. 2.

* * *

Having passed through one of the hottest months of June on record, it is refreshing to read that there is a project for operating cooling fans by compressed air obtained by volatilizing liquid air, and that this project is likely to become a success. The liquid is held in a suitable receptacle, while a coil connected with this receptacle constitutes a vaporizer and heater utilizing the heat of the atmosphere. The fan is revolved by a small turbine driven by the air under pressure, which, as it escapes from the motor, is caught by the fan blades and whirled forward in the current of air. In this way not only is the air in a room kept in constant motion, but it is continually cooled and freshened by the addition of the cold exhaust air of the motor.

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Entered at the Post-Office in New York City as Second-class Mail Matter.

MACHINERY

A practical journal for Machinists and Engineers, and for all who are interested in Machinery.

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS,

9-15 MURRAY STREET, NEW YORK CITY.

ONE DOLLAR A YEAR, POSTAGE PREPAID, TEN CENTS A COPY.
FOREIGN SUBSCRIPTIONS ONE DOLLAR AND FIFTY CENTS A YEAR.

Lester G. French, Editor.

Fred E. Rogers, Associate Editor.

The receipt of a subscription is acknowledged by sending the current issue. Remittances should be made to THE INDUSTRIAL PRESS, and not to the Editors. Money enclosed in letters is at the risk of the sender. Changes of address must reach us by the 15th to take effect on the following month; give old address as well as new. Domestic trade is supplied by the American News Company or its branches.

We solicit communications from practical men on subjects pertaining to machinery, for which the necessary illustrations will be made at our expense. All copy must reach us by the 5th of the month preceding publication.

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JULY, 1899.

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The regular edition of MACHINERY for July is 16,650 copies, AMERICAN MACHINERY is the title of the foreign edition, printed on thin paper and comprising all the reading and advertising matter in the domestic edition. No subscriber is entered on our mailing list until his subscription is paid for, and all subscriptions are stopped at expiration. No papers are sent free except to advertisers, exchanges and circulation agents.

The circulation of the three leading papers in the machinery trade, so far as it is possible to obtain the figures, is as follows:

The IRON AGE	7,000
The AMERICAN MACHINIST, about	12,000
MACHINERY	16,650

American radial drills have sometimes been criticized by those who live on the continent and in England because no provision is made for swinging the arm other than by muscular force applied directly to it. Several years ago, before the introduction of ball or roller bearings, there may have been some justice in this criticism; but at the present time the radial arms of the best drills are supported by "anti-friction" bearings and move so easily that if other means were adopted for moving them one of the essential features of the tool—quick handling—would be sacrificed. It seems to us that only in machines of abnormally large size, where the inertia of the arm is an important factor, is any change of the American plan demanded. While those who criticise the American design have overcome the objection of a hard moving arm by providing a more powerful means of moving it, Americans have preferred to overcome the objection by removing the cause rather than by adopting a cure.

* * *

It is comparatively few years since the analysis of flue gases was considered to be of much importance in boiler trials, but at the present time new evidences are continually at hand to show that increasing importance is being attached to the determination of the composition of the gases of combustion as they pass up the chimney. Mr. A. Bement calls attention in this issue to a striking instance where an error in weighing the feed water during a test was detected by the aid of the analysis of the flue gases, which was made at frequent intervals, and he has recently informed us of a case where the specifications recently drawn for a new boiler plant in Chicago called for a guarantee as to the quantity of carbonic dioxide that should be given off from the furnace.

The full importance of these gas determinations can be appreciated by the following statement taken from Prof. Benjamin's notes on heat and steam. "One pound of carbon combining with one and a third of oxygen forms carbonic oxide and gives off 4,400 British thermal units of heat, capable of evaporating 4.55 pounds of water at 212 degrees, Fahr. One pound of carbon uniting with 2 2-3 pounds of oxygen is said to be completely burned and forms carbonic acid (or carbonic dioxide), giving 14,500 British thermal units capable of evaporating fifteen pounds of water at 212 degrees." It will be seen from this that if the combustion be incomplete and carbonic oxide be produced instead of the dioxide, about seventy per cent. of the heat will be wasted. Improved apparatus is now made which makes it possible to determine easily and at any time what the percentage of the dioxide is and this is a good indication of the efficiency of the fire.

* * *

CHAINS FOR POWER TRANSMISSION.

It is not long since the use of chains for the transmission of power from one shaft to another was looked upon as a sign of poor workmanship and was taken to indicate that the machine on which the device was used was cheaply constructed throughout

We are not sure but that the same ideas hold to-day, and perhaps rightly so, because, as far as we have been able to observe, machines on which chain transmission is used are cheaply constructed and are not to be classed with the finer grades of work turned out. The use of the chain on the bicycle, however, is a notable exception to the rule, and is an example of what may be accomplished against heavy odds by persistent study and work. A chain, with its numerous joints, is not of a nature favorable to long wear or quiet running, particularly when it is exposed to dust or mud during the time that it is in use. Experience has shown, however, that a properly constructed chain, in the improved state to which it has now been brought, is at least as good as any other form of power transmission that has yet been used for bicycles.

The tests upon chains which are published in this number show that the ordinary bicycle chains may be counted on to sustain a load of from 1,000 to 1,500 pounds before breaking; or, with a factor of safety of six, a load of 200 pounds with perfect safety. These chains are well made and at the same time are produced economically, and there is no reason why they should not occasionally be applied in larger sizes to other high-grade machines.

As to the capabilities of chains for power transmission, they hold a position intermediate between belts and gears, giving a more positive motion than belts, but with more back-lash than gears, so that it would not be possible to time the parts connected with chains as accurately as can be done with gears. Their efficiency is high, however, and wherever it is not absolutely necessary to employ gearing to obtain the motion desired, and belting is objectionable, we can see no reason why the use of chains should not be an indication of good design and thorough construction rather than otherwise.

* * *

It will be remembered that Mr. Samuel Webber, in his first article upon shafting in the May number of MACHINERY, mentioned having met with a shaft in the spinning room of a mill which was so hot from repeated bending that he could not hold his hand on it. The shaft was supported by hangers on each side of a bay in the mill and a pulley from which power was taken was placed on the shaft midway between the two hangers. The belt pull on the pulley deflected the shaft and caused the fibers to be alternately in tension and compression, and Mr. Webber believed that a process of disintegration was going on that would eventually end in disaster.

There has recently come to our notice, a report of tests made by Prof. Gerome Sondericker upon shafting loaded at the center between two supports and driven until breakage occurred, which gives some interesting information about the performance of

shafts like the one found by Mr. Webber. Regarding his tests, Prof. Sondericker says: "It was noticed throughout the tests, that when running under any considerable set, the shaft was perceptibly warmer in the middle than at the bearings, the temperature increasing with the set. There was no accurate way of measuring this temperature. In four cases, however, the heat was sufficient to color the shafts. One running under a stress of 50,000 pounds, and a set of about .006" reached a full straw heat before breaking. Another, under 60,000 pounds stress, and still another under 32,000 pounds stress reached a blue heat before breaking, the set in each case being about .008". In all four cases, the break occurred near the bearings, i. e., where the shaft was coolest. This is in harmony with the fact that steel at a blue heat has a higher tensile strength than at a lower temperature. These results would seem to indicate that these high temperatures are not detrimental to the strength of steel under repeated stresses."

* * *

SOMETHING FOR NOTHING.

In nearly every branch of business men are sometimes led to believe that it is perfectly feasible to get something for nothing, but there is probably no department in which this delusion occurs so frequently as in mechanics. The more absurd the claims for a machine designed to attain the unattainable, the more readily are otherwise level-headed capitalists persuaded to sink thousands of dollars to "perfect it."

The "Power Multiplying Engine Co.," of Philadelphia, is now offering for sale "a limited number of shares of stock at a very low figure," for the purpose of "building an extensive plant to exhibit and convert the whole world to the truth of their statements." In New York City there is or has been on exhibition another power multiplying device, but the claims for it are not so sweeping as for the Philadelphia machine, since it is supposed only to triple the power, while the latter is designed to do ten times better than this, or increase the power thirty times. For our part we prefer the Philadelphia machine. There is more money in it.

These are only two of several similar schemes that have come to our attention, and they are fair samples of what is continually being given to the public to swallow. It is not alone business men and capitalists, however, who nibble at the bait. Mechanics are often caught in the same way, although we believe not always from the same cause. They generally understand that a gain in work or power is impossible without the expenditure of at least as great an increase of energy, but they do not always clearly understand how to determine whether there must be a gain in power to produce the results claimed for any particular device.

If a few simple facts be kept in mind, however, there need be no trouble in forming a sound opinion in most cases that are met with.

In the first place it should be remembered that in mechanics the measure of work done is the foot pound, a term which defines itself. A foot pound of work is the amount of energy required to lift one pound one foot high. A foot pound is therefore the product of force and distance, force being simply a push or a pull. A machine can be made to increase the acting force as is seen in the case of a crane, where the weight lifted is much greater than the force applied at the handle by the operator. It is also possible to increase the distance moved by some part of a machine, but it must be done by applying a greater force as in the case of a steam engine, where the distance moved by the belt is greater than the space passed over by the piston, but the total pressure of the steam against the piston is greater than the effective pull exerted by the belt.

In both the crane and the steam engine, however, the applied force multiplied by the distance through which it moves, in a given time, must be enough greater than the product of the force at the crane hook or the rim of the fly-wheel and the distance through which it moves to make up for the loss through friction in the machine itself. The foot pounds of work done by any machine whatever must always be less than the foot pounds put into the machine in the same length of time. A study of this principle and of the methods of applying it is all that is necessary to enable one to decide upon the soundness of the claims made for any power multiplying device.

LESSONS FROM COMMON THINGS.—1.

CLOCK MECHANISM.

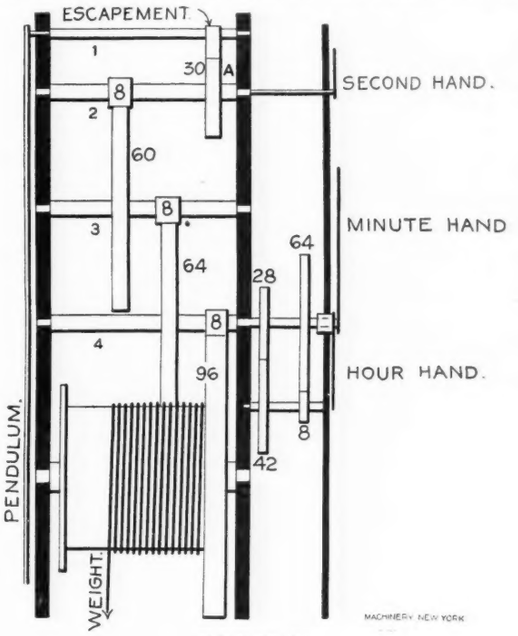
If one is of an observing nature and is able to do a little thinking on his own account, he need not remain entirely ignorant of the principles of mechanics, even though he be without text-book or teacher.

There is no one, probably, who could not obtain the works of an old clock for purposes of dissection, and it would be difficult to find a better piece of mechanism then this to teach the principles of trains of gearing.

In the accompanying sketch are shown the details of the works of a clock. This arrangement of gearing was a common one in the times when "old fashioned" clocks were not old fashioned, and the same or a similar arrangement is used more or less to-day.

The numbers attached to the different wheels indicate the numbers of teeth of those wheels and the pendulum, escapement, and hour, minute and second hands are at the points indicated on the sketch. The wheels are on shafts or arbors with bearings in two parallel plates, and the gearing for operating the hour hand is placed between the front plate and the face of the clock.

The escape wheel A has thirty teeth and with the usual form of escapement one tooth will pass at each double beat of the



CLOCK TRAIN

pendulum. In these old fashioned clocks, and in fact, in the best jeweler's clocks of to-day, the pendulums are made to beat seconds and one tooth of the escape wheel would therefore be released every two seconds. Thus the next shaft, 2, would revolve once in 2 x 30 = 60 seconds, or one minute, and can be used to carry the seconds' hand.

Shaft 4 carries the minutes' hand and to determine whether the gearing between shafts 2 and 4 will produce the right motion in four we will multiply together the numbers of teeth in the drivers and divide by the product of the numbers of teeth in the driven wheels and note the result. The two driving wheels have eight teeth each and the driven sixty and sixty-four teeth. Hence,

$$\frac{8 \times 8}{60 \times 64} = \frac{64}{3840} = \frac{1}{60}$$

and the minute hand revolves 1-60th as fast as the second hand, as it should.

Next, for the hour hand, we have

$$\frac{28 \times 8}{42 \times 64} = \frac{1}{12}$$

which is the ratio between the hour and minute hands that should exist.

Finally, the drum turns 8-96 = 1-12th as fast as the minute hand and as the latter makes twenty-four turns a day, the drum makes $24 \times 1\text{-}12 = 2$ turns per day, or sixteen turns in eight

days. This being an eight-day clock, provision should be made for winding sixteen coils of cord on the drum.

While the above may seem very simple to any who have read it, we venture to say that most mechanics would have found some difficulty in proportioning this train of gearing and a lesson may therefore have been learned from this clock, even if it is old fashioned and a very common mechanism.

* * *

PHOSPHOR BRONZE.

USEFUL INFORMATION ABOUT THIS VALUABLE PRODUCT.

The importance of bronzes for bearing surfaces and their extended use in service that requires the best of results under the most arduous conditions make the following extracts from an article that recently appeared on the subject in the "American Engineer and Railroad Journal" of peculiar interest.

Phosphor bronze is an alloy consisting primarily of copper and tin, to which phosphorus has been added as a deoxidizing agent. The action of phosphorus in this capacity will presently be considered at length. Phosphor bronzes for bearing purposes contain lead in addition to the copper, tin and phosphorus. Whether or not lead is introduced into the composition depends upon the character of service for which the alloy is intended.

The classification of phosphor bronzes of commerce may be made by dividing them into two general classes and designating them as high tensile bronzes and bearing bronzes. The former class is made up of alloys suitable for tubes, wire, springs, screws, etc., and for castings subjected to severe stress. For these purposes high tensile strength, toughness and resilience are required. The latter class includes alloys suitable for bearing parts of machinery, and may contain from 5 per cent. to 10 per cent. of lead. The lead, while greatly improving the bearing qualities, detracts materially from the tensile strength and toughness of the alloys. These latter qualities, however, are not of prime importance in the ordinary bearing and may readily be sacrificed in order to obtain a cool running, satisfactory bearing.

The use of phosphor bronze for locomotive bearings has been so generally adopted that at the present time it may almost be regarded as the standard bearing alloy in American railway practice. The results of investigations by Dr. C. B. Dudley of bearing metals on the Pennsylvania Railroad have undoubtedly had much to do with the general adoption of phosphor bronze as a railway bearing alloy. Dr. Dudley's investigations, published in the Journal of the Franklin Institute, February and March, 1892, demonstrated by comparative trials of various bearing alloys, the superior qualities of phosphor bronze.

The composition of Pennsylvania Railroad Standard Phosphor Bronze, as published by Dr. Dudley, and which, with slight variations, has been generally adopted by other railroads, is as follows:

Copper, 79.7; Tin, 10.0; Lead, 9.5; Phosphorus, .8.

The practice of the Chicago, Burlington & Quincy Railroad is represented by the following recent specification:

"1. Phosphor bronze must have the following composition in borings taken from any ingot or casting in the lot:

Copper not less than 77 per cent. nor more than 81 per cent.

Tin not less than 9 per cent. nor more than 11 per cent.

Lead not less than 9 per cent. nor more than 11 per cent.

Phosphorus not less than 0.7 per cent. nor more than 1 per cent.

"2. Ingots must have a concave or shrunken surface on the upper or open side.

"3. Castings must be free from blow holes and porosity; their fracture must show an even appearance and must be entirely free from oxides and dirt.

"4. Material failing these requirements will be rejected."

In order to understand the action of phosphorus in the manufacture of bronzes, one must take into consideration the characteristics of their principal component, copper. Copper in its molten state exhibits a strong affinity for oxygen. If a crucible of molten copper be exposed to the atmosphere without having over its surface a layer of charcoal, glass or other protective covering, the metal will absorb oxygen from the air. Also oxides of copper, if opportunity is afforded, are readily taken into solution by the molten copper. Oxygen, when present in an alloy of copper, is extremely prejudicial to satisfactory results when a uniformly strong, tough structural bronze of a homogeneous cool running bearing is desired. When the alloy having absorbed oxygen is cast, the copper oxide segregates near the upper surface of the ingot or the casting, in a discolored mass, which on account of its black, greenish or reddish appearance, is visible in the fracture when the casting is broken. These spots will be a source of weakness if strength is desired, or will form hard spots of poor bearing qualities if a good bearing is wanted. In the ordinary course of events, in the manufacture of bronze it is almost impossible to prevent copper from absorbing some oxygen, therefore, in order to get rid of the oxygen recourse is had to the use of some flux or deoxidizing agent. This flux, uniting with such oxygen as may be present, forms a constituent of a slag, which, separating out and rising to the top, leaves the alloy free from oxygen and renders possible the production of sound castings of homogeneous structure. Various fluxes for bronzes have been successfully used, among which are phosphorus, manganese, silicon, zinc and aluminum, each having its especial peculiarities, advantages and disadvantages. However interesting these may be, our consideration will be confined to the first mentioned of these; viz., phosphorus.

Phosphorus is a non-metallic substance, and is known to commerce in two forms, red phosphorus and yellow phosphorus. These two forms, while identical chemically are widely different in physical appearance and behavior. Yellow stick phosphorus is the form chiefly employed for bronzes. Stick phosphorus is translucent, yellowish white in color, and of a waxy consistency; not unlike a tallow candle in weight and general appearance. The sticks are cylindrical, about 9-16 inch in diameter and 11 inches long. The material is received from the manufacturers in sealed tin cans, each containing about fifty sticks immersed in water. As above noted the function of the phosphorus in the bronze is that of a cleansing agent rather than as a vital element in its fundamental make-up. In fact a large excess of phosphorus over the amount needed to deoxidize the alloy is in most cases undesirable. The effect of excess of phosphorus upon the physical qualities of bronze is to increase the hardness at the expense of toughness and malleability, furthermore it lowers the melting point. Excellent bronzes for certain purposes may contain only a trace of phosphorus. For parts requiring strength or toughness, chemical analysis should not show to exceed 0.2 or 0.3 per cent., and for bearing parts not to exceed 0.8 per cent. to 1 per cent. The fracture of a phosphor bronze casting intended for bearing purposes should present a close grained, uniform, mouse-colored appearance, free from segregation and discolored oxide spots.

To obtain proper results with phosphor bronze, care must be taken with its manipulation in the foundry. Even with the best materials in correct proportions, unless care and judgment are exercised in the foundry treatment, the product will be unsatisfactory, and perhaps even unfit for use. In this connection it may be remarked that at the proper heat of pouring, the alloy should be cooled down almost to the temperature at which it begins to solidify. If poured too hot, a segregation of components will result. If such a hot poured casting be broken, the mottled appearance of the fracture will plainly show the segregation which has taken place. In fact, with bronzes in general the appearance of a freshly made fracture furnishes an excellent medium for judging the qualities and properties of the alloys.

The methods of introducing phosphorus into a bronze are quite numerous, but the following are three most commonly used: 1st. By adding stick phosphorus direct into the crucible of molten bronze. 2d. By adding to the other bronze constituents, phosphor-tin consisting of about 95 per cent. tin and 5 per cent. phosphorus. 3d. By adding phosphor-copper consisting of from 5 per cent. to 7 per cent. phosphorus, the balance being copper. The latter method is perhaps the most practical and easiest way of introducing it.

* * *

The Iron Age says that the whistle at the Atlanta Milling Co.'s new mill at Atlanta, Ga., has been constructed to be audible at Macon, forty miles distant. It is 8 ft. in height and consists of three bells of a special composition of bronze and bell metal, arranged between two disks of steel. The larger bell has the mouth turned upward, and the other two have their mouths turned downward; a 3 in. pipe conveys the steam through shallow openings in the circular disks. The bells are tuned to an eighth and a fifth of a chord, and harmonize as accurately as the best tuned piano. The amount of steam required to sound the bell would run a 75 horse-power engine.

A NEW SHOP SYSTEM.—5.

DEALING WITH THE ORDERS FROM THE SHOP, THE COST OF LABOR AND MATERIALS, THE DISTRIBUTION OF PLANT CHARGES, THE COST KEEPING, ETC., AS CREATED TO MEET THE REQUIREMENTS OF A PLANT DEVOTED TO THE MANUFACTURE AND SALE OF MACHINE TOOLS.

GEO. D. CHAPMAN.

New Asset Account.

The New Asset Account contains the Main Accounts A, B, C, D, and E, (See Distribution of Plant Charges previously shown.) and these Main Accounts contain various Sub-accounts.

The charges againts A, B, C, D, and E are of two kinds, i. e., Labor Charges and Bill Charges.

Now to figure this New Asset Account.

The entries under Labor Charges on each line are added horizontally and the total put down in the Labor Charges, Total Monthly column.

The sum of the entries in each Sub-account column, under Labor Charges is set down at the foot of the column in line with the proper month.

Now add horizontally all the column footings in line with the given month, and set the total down in the Labor Charges, Total Monthly column on the same horizontal line, check this New Asset labor charge for the month by adding vertically the totals, previously figured in the Labor Charges Total Monthly column.

Jan., '99. Add for expense 90.0 % labor.

ACCOUNT.	Labor.	%	Bills.	%	Total.	%
New Ass.....	3735.79	65.3	1396.70	50.3	5132.49	60.4
Sell Expense....	583.54	10.2	385.05	13.9	968.59	11.4
Mfg. "	1401.64	24.5	991.98	35.8	2393.62	28.2
Total.....	5720.97	100 0	2773.73	100.0	8494 70	100.0

FIG. 20. MONTHLY REPORT CARD.
Size, 3 in. x 5 in. Color, white.

The entries made under New Assets, Bill Charges are figured in a like manner.

Now add horizontally the Labor and Bill charges in the Total Monthly columns and set the sum down, on the same horizontal line, in the Grand Total Monthly column.

At the end of the three months the three sub-account column footings are added together and the amount set down at the foot of the columns in a horizontal line with the Total Three Month, then an average for each is figured and entered in line with the Average Three Months. This gives the total and the average for the three months charged in New Asset against each Sub-account.

Selling Expense and Manufacturing Expense Accounts.

The Selling Expense and Manufacturing Expense accounts are figured in the same manner as the New Asset account above described.

Summary.

At the extreme bottom of the Monthly Report Sheet is given a summary of the New Asset, Selling Expense and Manufacturing Expense accounts, together with the per cent. of each, and the per cent. of the New Asset Labor, Charge, which would cover the Total Expense account; this is total Selling Expense plus total Manufacturing Expense divided by New Asset Labor charge. These are also averaged every three months.

Monthly Report Card.

Each month the summary at the bottom of the Monthly Report Sheet is drawn off onto a card as shown above.

Now that the complete monthly report has been made all of the Cost Sheets for that month which refer to any accounts except those upon which specific cost is being kept, i. e., Piece or Job Number accounts, Cost Sheets, these Cost Sheets remain upon the file boards until the pieces or jobs are done; the Cost Sheets, which refer to the other accounts are filed away each month.

When the pieces or jobs are completed the New Machinery Orders and the Shop Orders are given to the Cost Clerk stamped in Completed (See the Engineering Department rules previously explained) and he makes the report upon these pieces or jobs, as will be described later.

When the reports above referred to are made, then the Cost Sheets which apply to these reports are taken from the file board and bound together, the outside cover being an index of the contents. At the same time a blue sheet, the same size as the cost sheets, is made out, which sheet contains the same index matter as the cover sheet above referred to. This sheet is filed among the Cost Sheets for the month in which the pieces or jobs were completed and reported, the sheets are filed in the same position as if they were merely Cost Sheets.

This keeps the Piece Number cost sheets bound together by themselves so that they may be easily referred to and at the same time does not unnecessarily encumber the monthly file.

Monthly File.

In regard to the monthly file which contains the Cost Sheets for each month, as above described, a short explanation will be in order.

The Cost Sheets for January to June inclusive are filed together each year, and those for July to December inclusive, in another file; therefore, each file contains the Cost Sheets for six months and two files only are required for each year.

Guide sheets are provided for these files, the size of the cost sheets, with tabs projecting at the bottom, one for each month. The Cost Sheets for each month are filed above the corresponding guide sheet and in the order of the Main or letter accounts as given upon the Distribution of Plant Charges, ("A") account on top, ("B") next, etc. In each Main account the Sub-accounts run in the order given upon the Monthly Report Sheet previously described, beginning with 13L at the top, then 14L, etc.

On the top of these sheets for each month is placed the Monthly Trial Balance sheets, which are of the same size as the cost sheets. On top of these Monthly Trial Balance sheets is placed the sheet containing the 2 in. x 3 in. blue slips, which give the Pay Roll Trial Balances previously described.

This filing puts all Cost Sheets in such an order that they can be readily found when required.

Monthly Statement Cards.

A report is made each month as shown below, which gives some valuable information in an accessible form. Each card contains the information for six months.

1899, Date.	DAILY.			Month's Labor.	DAILY.		Month's Sales Made.
	No. Men.	Hrs.	Men, hrs.		Labor.	Wage.	
Jan.....	97	9.8	950.6	5720.97	220.01	2.27	8250.80 F 5300.10
Feb ...	.....	.....	.....	.....	.....	.....	.....
Mar....	.....	.....	.....	.....	.....	.....	.....
April ..	.....	.....	.....	.....	.....	.....	.....
May....	.....	.....	.....	.....	.....	.....	.....
June ...	.....	.....	.....	.....	.....	.....	.....
Total...	.....	.....	.....	.....	.....	.....	.....
Ave..	.....	.....	.....	.....	.....	.....	.....

Foreign sales % ..... Total .....
Av. .....

FIG. 21. MONTHLY STATEMENT CARD.
Size, 3 in. x 5 in. Color, salmon.

The No. Men and Hrs. is obtained from the calendar, which is kept by the Cost Clerk as previously described on page 303, the sum of the men working each day divided by the number of working days gives the entry in the Daily Number Men column in this case 97.

The same method in regard to the hours gives the entry for the Hrs. column as 9.8.

The product of these two gives the Men Hrs. or 950.6.

The Month's Labor is taken from the Monthly Report Card or $5720.97. The Daily Labor is the Month's Labor divided by the number of working days in the month, or ($)220.01 and the "Daily Wage" is this amount divided by the Number Men or 97, which is ($)2.27.

The Month's Sales Made is taken from the Order Book, both for domestic and foreign sales; in this case the domestic sales are 8250.80 and the foreign F5300.10.

The Monthly Report Cards and the Monthly Statement Cards are filed in the same till. The Monthly Statement Card is placed first and directly behind that the six Monthly Report Cards which cover the six months specified upon the Monthly Statement Card preceeding; then another Monthly Statement Card and six more Monthly Report Cards and so on.

Piece and Job Number Reports.

The Cost Sheets for the piece costs are made out as described upon page 303, when the Shop Order is received by the Cost Clerk; these sheets are filed upon the proper file board.

When all of the Orders specified upon the top Cost Sheet upon this file board, i. e., all of the New Machinery Orders and Shop Orders (N.M.O's. and S.O's.) there specified, have been given to the Cost Clerk stamped in Completed, and hung, in order of the date completed, that is the last date on top, upon the outside of his file board; then a 1½ in. round green poker chip is put upon the left hand post of the arch. This signifies all labor is now completed. The N.M.O. and S.O., as they come to the Cost Clerk, are filled in, when completed, as shown on page —. The date upon which the labor was completed and upon which the last Labor Charge will appear upon the Cost Sheets against these Orders, is then shown upon the top order, at the bottom, in Completed. In the case of the S.O. shown this date is 1-2-'99 and for the N.M.O., it is 1-12-'99.

The report upon these cannot therefore be made until all of the Labor Charge items, including those upon the date of completion of the orders have been entered and the Cost brought forward. This means that the report cannot be made until the Pay Roll Trial Balance—which includes the completed date has been drawn off and reported.

When this Pay Roll Trial Balance is drawn off a 1½ in. round red poker chip is put upon the right hand post of the arch and the green one is removed. This red chip says, through the eye, "The Labor Charges are all entered and the Cost brought forward, so it it now all ready to be figured and reported."

By this system the Stock is not charged off against the Cost of a piece until the Report is being made, which is very convenient and is the means of saving much time. Furthermore, as the Stock is reported upon the blue print lists no other stock orders are required, and as each list contains a large number of pieces there are less orders to handle than would be the case if the stock for each piece was reported separately.

Referring again to the Stock column the Price is next entered, from the price file, which the Cost Clerk has at hand, or ($).025 (Per lb.) and the total of ($)1.70 figured.

The right hand column is next in order; Hrs. ea. pc. is the total number of hours divided by the Lot Of, or in this case 765.65 (Hours) ÷ 60 = 12.76 (hours). The Av. Wage is the total labor cost divided by the total number of hours, or ($)194.594 ÷ 765.65 (Hours) = ($).254 (per hour).

It is of advantage to know the Hrs. ea. pc. and the Av. Wage, for it helps in again assigning the piece, as it may be cheaper to give the work to men who will take more Hrs. ea. pc.; but who are paid less Av. Wage. Again if the cost of the piece is excessive the first consideration is in regard to the Hrs. ea. pc. and the Av. Wage.

The Labor ea. pc. is obtained by dividing the total labor cost by the Lot Of, or ($)194.594 ÷ 60 = ($)3.24. This must be checked by multiplying the Hrs. ea. pc. by the Av. Wage, or 12.76 (Hours) × ($).254 the Labor and Stock = ($)4.94.

The Expense is taken as a certain per cent. of the labor cost, as figured each month on the Monthly Report Sheet and drawn off, for quick referance on the Monthly Report Cards, as described on page 304; the average per cent. expense for several

4-20-'98. 13 L-4. L-393

COMPOUND CARRIAGE.

Date, Jan., 1899.

Name.	Pc. No.	Stock.	No. Pcs.	Lot of	Hrs. each Piece.	Ave. Hourly Wage.	Labor.	Stock.	Cost Labor and Stock.	Expense.	Total.
Carriage gib	13L 68	C. I.	1	60	1.78	.116	.21	.10	.31	.19	.50
"	13L 69	"	1	60	12.76	.254	3.24	1.70	4.94	2.92	7.86
					Totals....	$	$	$	$	$	

Total weight.....lbs.
Cost per lb. $..... Total per lb. $.....

FIG. 23. TOOL COST SHEET.

Size, 10 in. x 13½ in. (The ⅝ in. on the left hand edge is saved for binding these sheets together.)

To sum up; when the last N.M.O. or S.O., has been received by the Cost Clerk, which makes up the total N.M.O's. and S.O's. specified upon the top of the top Cost Sheet, and these orders have been filed upon said file board, a green chip must be hung upon the left hand post of the arch. When the Pay Roll Trial Balance, which includes the completed date, has been reported a red chip must be hung upon the right hand post of the arch and the green one removed.

Report.

Now to make the Report we will take the case in hand that for the 14 in. Gem Lathe, known as Class 13L. A number of Shop Orders have been issued and as shown by the Record on page 2, all were completed in January '99, and we will assume that all of the N.M.O's., and S.O's. were completed in that month and by the system the file has borne a green chip and then a red one; so the Report is in order.

To obtain the stock, kind and weight, the Casting, Steel and Miscellaneous blue print lists, which are shown on page 276 as returned, are required.

Referring to the Cost Sheet, shown on page 302, the Cost of piece 13L-69 is there figured, all of the following entries being made with black ink. The date Started is the date of the first Labor Charge item or 10-19-'98.

The Stock column is next in order, for the Completed date will be described later. The entries for this Stock column are obtained from the Casting, Steel and Miscellaneous blue print lists; in this case from L-332 shown and described on page 276. There the date of Stock Rec'd is 10-18-'98, this is entered in Date; the Kind is put down as C.I. (Cast iron), the Weight as given in pencil upon L-332 is 68 (lbs.) If the weight had been previously ascertained, if would have been taken from the former Report and the Date entered would have been that of the former Report.

months is taken as being more nearly correct. In the case in hand this per cent. is taken as 90.0, therefore, the Expense is ($)3.24 × .900 = ($)2.92 and the Total is ($)4.94 + ($)2.92 = ($)7.86. This gives the total cost of one carriage Pc. No. 13L-69 but does not include any profit.

Tool Cost.

If the Report is for complete Parts of a Tool, as in this case, the file board will contain Cost Sheets for each and every piece contained in said Parts, which was built in this lot.

Blank Tool Cost Sheets are used in making the report of the Parts which is of the form shown above.

One or more Tool Cost Sheets are taken, as the case may require, for each Part of the Tool.

The sheet is headed the same as the list of pieces (Casting list, etc.) in this case 13L-4 and Compound Carriage, 13L is the Class, 4 is the number of the Part and Compound Carriage is the name of the Part.

The entries upon this sheet are all made with black ink, except for the pieces, the cost of which are taken from a previous lot or are estimated, these are entered in red ink, for these pieces were not built in the lot in hand.

The Name, Pc., Number Stock and Number Pcs. columns are all filled in first. These are drawn off from the Casting, Steel and Miscellaneous blue print lists which refer to each Part as shown upon the bottom of the Shop Order from said Part, in this case L-332 and L-334.

The casting pieces are entered first, then the steel and lastly, the miscellaneous pieces.

This makes in most cases, for the large variety of Tools for which this system was created, about eight Tool Cost Sheets for all the Parts which form a completed Tool.

The entries in the following columns, i. e., Lot Of, Hrs. ea. pc., Av. Hourly Wage, Labor, Stock, Cost, Labor and Stock, Ex-

pense and Total are all drawn off from the Cost Sheets which are upon the file board, except for those pieces not built with this lot, in this case the entries are made in red ink from a previous lot or estimated.

As these items are drawn off from each Cost Sheet the date is entered with black ink under Completed, upon said Cost Sheet as shown. This date is the month in which the last Order was completed, either N.M.O. or S.O., and is the month to which this Report is assigned and in which the blue sheet referred to on page 304 is filed, in the case in hand January, '99.

When these entries are all made upon the Tool Cost Sheets, each Part is figured, that is, the columns are summed up and the totals entered, then the Total Weight is set down and the Cost per lb., figured and set down, this is the total cost labor and stock divided by the Total Weight. Then by the same process the "Total per lb." is figured.

These sheets are then fastened together along the left hand edge, with a blank sheet on top; upon this blank sheet is given a summary of the costs, etc., as shown upon the front side of the Tool Cost Card described below.

All piece costs which are larger than those of a previous lot are listed and reported for investigation.

Tool Cost Card.

For each Tool Report a summary is made out upon a card as shown below which is known as a Tool Cost Card. The entries to be made upon this card are self-evident.

D Jan., '99.	Lot of 60	14 x 6 L Gem.						13L	
Part.	Labor.	Stock.	Cost.	Cost, Lb.	Part.	Labor.	Stock.	Cost.	Cost, Lb.
Head					S. rest				
Tail					Counter				
Car					Legs				
Apron					Bed				
Screw					Ass.				
Hangers									
Scr. gears					Total				

Total Wt., ... Lbs. Cost Lb. .....

FIG. 24. TOOL COST CARD, FRONT.

Labor		
Expense		% labor
Stock		
Total		per lb.
†Sold @		
Profit or loss		
" " "		ea. % of †
Brought forward profit or loss		on lot of
Total profit or loss		

FIG. 25 TOOL COST CARD, BACK.
Size, 3 x 5 in.

In figuring the back of this card if the account figures a loss the entries for that loss are made with black ink, if a profit red ink is used. This gives at a glance the financial condition which exists with any Tool.

In regard to the color of these cards, if the Tool Cost Card be the first one of that Class a blue card is used; while all subsequent Tool Cost Cards for that Class are white. The upper right hand corner of all Tool Cost Cards for each Class except the last one filed in that Class are cut off; this method is used in all files where the cards refer to the same subject.

The Report now having been made the blue sheet mentioned on page 304, is made out and all the Cost Sheets are taken from the file board and bound together with a sheet on the outside, filled in the same as the blue sheet, which gives an index of the contents.

If the Report is of pieces or jobs and not of complete Parts then the Tool Cost Sheets are not made out, but the report is made directy upon a Cost Card, size 3 in. x 5 in. color salmon.

A Cost till is reserved for these Cost Cards and is provided with salmon 1-5 center guide cards, these cards are lettered A, B, C, etc., signifying each Main account as shown upon the Distribution of Plant Charges and between each of the salmon guide cards are placed as required 1-5 buff guide cards labeled for the Sub-accounts.

The "Cost Cards" are placed in their proper Main or letter account and Sub-account; the Tool Cost Card here shown is placed behind the Main account guide card (D) and directly behind the Sub-account card 13L.

The Commercial Value.

A few facts of commercial value owing to their accesibility and reliability, which are obtained by this system will here be given.

WANTED—The kind and size of Tool and to whom sold; the Tool Number being given. Refer to the Sold Tool till and there arranged numerically behind its proper number guide card will be found the Tool Card of the Tool Number wanted. (For sample of Tool Card see page 277.) If further details are required in regard to construction these may be quickly traced through the Record (page 277) and the drawings. If terms, etc., are wanted consult the Order Book under the sold date as shown on the Tool Card, in this case 1-2-'99.

WANTED—The Tools sold any given party. Consult the Trade Sold till and alphabetically arranged the Trade Sold Card (Page 277) for the party will be found. Further details can be found by the Tool Number through the Tool Card as above described.

WANTED—The past and prospective customers in any town. Consult the Trade till and behind the State guide card the Trade Card (page 277) will be found alphabetically arranged according to the name of the town. If the name has a V opposite it the party is a past customer and further details can be found by consulting the Trade Sold till as above mentioned.

WANTED—The Class of Tools which are being or have been sold in any month or year. Consult the Sold Tool till and the Sold Tool Cards therein as described on page 277.

WANTED—The stock of completed Tools and Top Works on hand completed and Started in Works. Consult the Delivery Sheet (page 301). For further details of the completed Tools look over the Tool Cards in the Tools on Hand till and the Record specified and the drawings thereon. For further details in regard to Tools and Top Works, Started in Works look over the New Machinery Order and Shop Order stock in progress files. These files are essential in keeping watch of the work in progress, the stock received, etc.

WANTED—The time it has taken to build any Parts. Consult the Record (page 277) for there is given the date started and the date completed. Further details may be obtained by consulting the Shop Order for that time and lot, this will be found filed upon the S. O. Completed file board.

WANTED—The cost of any Tool or Part. Consult the Cost till described on page 302, and therein the "Cost Card" desired described on page 302. This may be further traced through the Tool Cost Sheets, page 302, and then the Cost Sheets (page 302). Upon these sheets the Hours and labor Cost charged against each Number Man can be ascertained, and if further information is desired the Daily Time Slip (page 302) can be examined and there the Operations are specified.

WANTED—The New Asset, the Selling Expense and the Manufacturing Expense accounts for any month or period and their relative value, also the Expense percent. Consult the Monthly Report till and there find the Monthly Report Card as described on page 341, if the sub-division of these accounts is desired consult the Monthly Report Sheet as described on page 341.

WANTED—The number of men employed, etc., at any time. Consult the same till as above and therein the Monthly Statement Card as described on page 341.

WANTED—The total sales and the proportion of foreign sales made in any month or year. Consult the same till as above and on the proper Monthly Statement Card will be found this information.

It has been the constant aim to produce for the least money, in a Plant manufacturing and selling a large line of machine Tools, accurate information, ready at hand of facts which one ought to know in order to keep well informed in regard to all sides of his business, which is necessary in order to make a commercial success.

* * *

Some idea of the complication of machinery in a modern battleship may be gained from knowing that the Wisconsin, which is now being built by the Union Iron Works, will have nearly 80 engines for the auxiliary service besides the two sets of triple-expansion engines of 10,000 H.P. that furnish the motive power.

LETTERS UPON PRACTICAL SUBJECTS.

CHECKING BOILER TESTS BY GAS ANALYSIS.

Editor MACHINERY:

The accompanying diagrams illustrate one of the valuable features of combustion gas determination. Fig. 1 shows a plotted curve of pounds of water evaporated per pound of coal and the accompanying curve of carbon dioxide in the combustion gases. These curves are from eight boiler trials all made on the same boiler and furnace at various times.

The case in point is that of trial No. 2, in which there is a most remarkable disagreement between the curves as compared with the other trials. This test and No. 1 were made at a later date than the other six and were run for experimental purposes with the largest and smallest possible air supply as are indicated by the points of carbon dioxide. These points are located in No. 1 at 10.25 per cent. and in No. 2 at 7 per cent. The amount of water was ascertained by a reliable meter, and the quantity of coal burned at each test was 1800 pounds, the

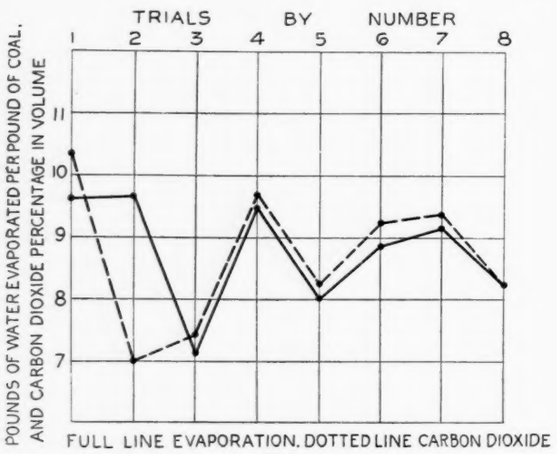

TRIALS BY NUMBER
1 2 3 4 5 6 7 8
11
10
9
8
7
POUNDS OF WATER EVAPORATED PER POUND OF COAL, AND CARBON DIOXIDE PERCENTAGE IN VOLUME
FULL LINE EVAPORATION. DOTTED LINE CARBON DIOXIDE

FIG.1

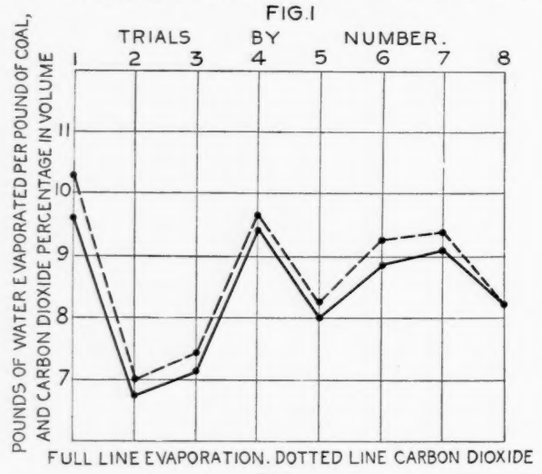

TRIALS BY NUMBER.
1 2 3 4 5 6 7 8
11
10
9
8
7
POUNDS OF WATER EVAPORATED PER POUND OF COAL, AND CARBON DIOXIDE PERCENTAGE IN VOLUME
FULL LINE EVAPORATION. DOTTED LINE CARBON DIOXIDE

FIG.2

time being the same in each case. Independent observers noted the quantity of water and carbon dioxide and the startling apparent result of No. 2 was immediately questioned. When plotted with the other trials the inconsistency was at once exposed, the error being in reading the water meter. The quantity of water was noted at one observation while the carbon dioxide is the average of a large number of corroborative observations taken two and one-half minutes apart. It will be seen that there was scarcely a possibility of an error with the latter observations and with the coal weights there was an agreement with little chance for error as the full amount was weighed in each case before the beginning of the trial. The diagram No. 2 shows a more consistent location of the curves, the point of evaporation being assured.

It might be said that this is a very simple and valuable check on boiler trials as it tends to point errors of this character which may be more frequent than there are usually means of ascetaining. This fact is attested to by a similar case which came under my observation recently.

A. BEMENT.

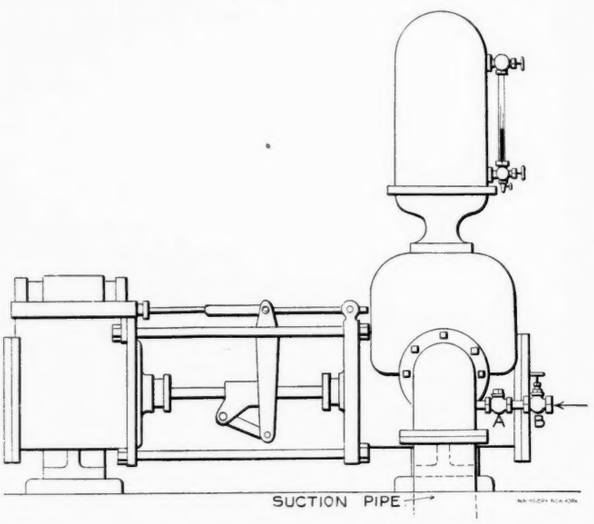
Chicago, Ill.

* * *

AN AIR CHAMBER CHARGING ARRANGEMENT.

Editor MACHINERY:

The accompanying sketch shows a simple scheme that is a help toward the smooth working of a steam pump. It consists of a check valve A and the globe valve B to regulate the admission of a constant supply of air with the incoming water. A hole is tapped in the elbow for this purpose and tapped for a one-quarter inch pipe, the check and globe valves being of this size.



A small quantity of air is drawn in with each stroke of the water piston, which acts as a cushion to the water in the suction pipe and tends to prevent water hammer. When the water is discharged from the cylinder, the air goes with it and replenishes the air chamber, but if the chamber be full the air is delivered with the water to the boiler or whatever place it may go. Some engineers object to air in their boilers, but I can see no particular objection to it and the advantages of having the air chamber always charged with air are obvious.

SUBSCRIBER.

["Subscriber" has shown a check valve in connection with the charging arrangement, but it seems unnecessary as the water will not escape through the opening even if the pump be not working. The writer has observed an ordinary pet-cock successfully used for the same purpose. The valve should be closed, however, when the pump is shut down so that the water will be retained in the suction pipe, otherwise the admitted air will allow the water to settle to the level of that in the well.—EDITOR.]

* * *

TOOL TRAYS.

Editor MACHINERY:

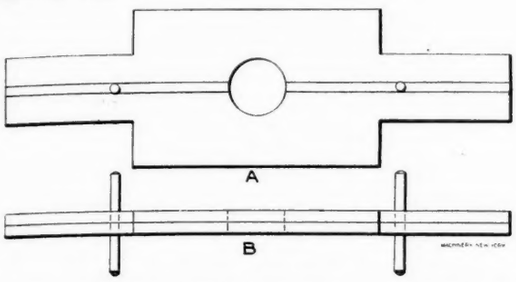
A tool maker usually has a number of costly tools and to keep them from being knocked about or marred in any way he generally has a case for each one. This is all very well if only one tool is to be used at a time, but when a number are being used on the same job, as is usually the way, the multitude of cases are somewhat troublesome. To do away with the inconvenience attendant to such a condition I have adopted the use of a tray 5 x 12 x ½ inches deep, which is lined with felt and have given up the use of the individual cases entirely. Upon finishing work for the day I am able to gather all my tools up at once and put them in the box without stopping to put each one in its case. In the morning all the tools that are required for the unfinished job can be picked up at once and carried to the work. This scheme admits of leaving all the tools in the adjustment as used on the work and saves rummaging through the tool-box to get the proper assortment with the chances of leaving behind some that will be needed.

Toronto Junction, Can. J. R. S.

TO FIND THE BLANK.

Editor MACHINERY:

The operation of "finding the blank" is one of the fine jobs in making, forming and drawing dies for sheet metal. In nearly every instance, either the ends or the sides or both, of the blank require to be symmetrical. The following method is simple, logical and is also the quickest way of accomplishing this result and yet I have seen many good die makers who are not familiar with it.



Suppose we have a simple bent piece to make which will require a blank the form of Fig. A. Take two pieces of sheet stock, clamp them together and drill two small holes a convenient distance apart and fit with sliding pins, as in Fig. B. Scribe the two lines shown in Fig. A, along a straight edge held against the pins. These lines indicate the middle of the blank and from them lay out the required shape, making the ends of equal distance from the holes. File approximately to the shape laid out and finish by the process of reversing on the pins and filing the edges flush each time until, no matter which way they are placed, the two pieces show exactly alike all around. Suppose there needs to be a hole exactly in the center, as in Fig. 1. Lay out as close as possible and drill through both pieces while together with a drill smaller than the size of the required holes. Reverse the pieces and ream with a taper reamer. Reverse again and run the reamer through a little farther. Repeat this operation several times and finally finish with a straight reamer the required size. The result will be found very satisfactory.

H. B. McCABE.

* * *

SUBSTITUTES FOR "PUTTING-ON TOOLS."

Editor MACHINERY:

There are times when a mechanic would be willing to give a generous share of his worldly possessions to have a putting-on tool in his tool chest. When he has to report a job turned too small or bored too large, and the cold chills begin to creep down his back, a putting-on tool would afford him more solid comfort for the time being than a summer vacation with all expenses paid.

While such a tool may be beyond the realm of possibility, there have been many sleepless nights spent in devising ways and means for increasing the amount of stock in places where too much stock has been removed and the ingenuity and skill displayed in "making pieces go" sometimes places this class of work on a par with the best products of our shops. A man will never work as hard nor display as much ingenuity as when he is trying to get out of a scrape.

During the late war a job came to my attention that was the nearest approach to actually putting on stock that I have heard of. Its successful completion saved the company a handsome sum and altogether it was a very commendable undertaking. I trust the man who carried it through received substantial recognition from his company.

The company were manufacturing twelve-inch guns for the government. The guns were of the built-up type with hoops shrunk on the barrel at the breech. One of these guns had been nearly finished; the hoops had been turned and shrunk in place and the barrel had finally been bored and reamed. When the reamer was withdrawn and the barrel cleaned for inspection, it was found that the bore was a small amount over the maximum limit required by the government specifications and the gun, worth several thousand dollars, was apparently ruined. There was one slim chance for saving it, however, which seemed to be so impossible that most men would declare on the face of it that it was no chance at all. The gun had yet to be rifled and there was a bare possibility that in the rifling process the metal could be so upset and expanded toward the center of the bore that there would be enough metal between the rifle grooves to allow another reaming. Accordingly, the gun was partially rifled, the grooves not being cut their full width or depth ,and then a wedge-shaped tool, which we may call an expanding tool, was fastened to the rifling bar, in place of the cutter, and drawn through the grooves. The result was to upset the metal sufficiently to allow a second reaming, and the government finally accepted the gun.

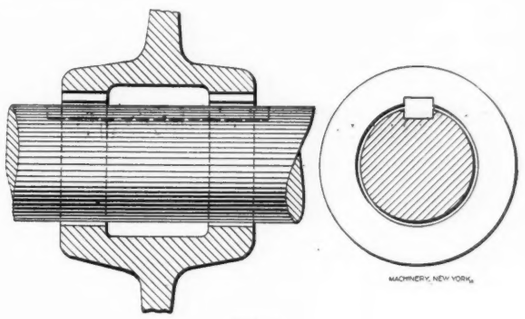


FIG. 1

Another job that has come to my attention, which, while not quite so much like putting on stock, is interesting from the fact that it was a successful attempt to make a good and secure piece of work out of one that had apparently been spoiled. A second-hand engine was being repaired and was to be fitted with a five-ton fly-wheel, which was to go on a nine-inch shaft. The hub of the wheel was bored too large and the shaft and hub looked about as shown in Fig. 1 when they were ready to go together. While this was discouraging, it was thought best to try to save the wheel for this job and the method adopted was that shown in Fig. 2.

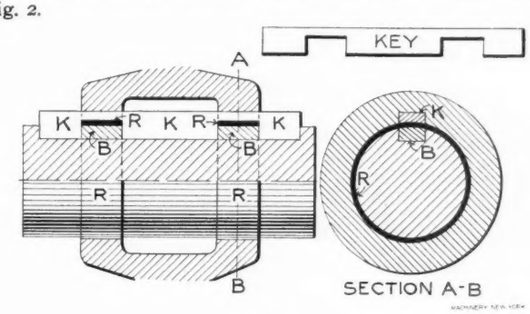


FIG. 2.

The keyway of the shaft was lengthened somewhat and blocks B, B, were set in it at the points where the hub was to bear, the hub being cored out in the central part so that it should bear only at the ends, as indicated. Two wrought iron rings, R, R, were then shrunk on the shaft at these same points, the two blocks serving to keep them from flattening where they passed over the keyway. A key was made with notches of the shape indicated to allow it to fit over the ring and the blocks in the keyway. The pulley hub was bored out large enough to fit the rings on the shaft and after dropping the key in the slot the hub was forced onto the shaft and the job was complete. The bearing of the key in the shaft was at the ends and in the center between the rings and the bearing in the pulley was the same as usual.

OLIN SNOW.

* * *

FOR YOUNG DRAUGHTSMEN.

Editor MACHINERY:

Many readers of MACHINERY who are practicing mechanical drawing at home will no doubt at times get "stuck" with their limited drawing outfit. Such was my lot on many occasions and in some cases I got over the difficulty by simple makeshifts, a description of which may be of interest to your readers, and help them over difficulties which arise when special tools are not at hand.

Having arcs of a larger radius than my compass with lengthening bar inserted would draw, I took my plain dividers and compass and tied them together. They answered my purpose as well as a beam compass and the way I tied them together so

as to avoid shaking was as follows: Turn the legs of the plain dividers around (inside out), then place the point leg of the compass in the opening of the joint of plain dividers and with a strong piece of cord tie them firmly together, the cord crossing at both bottom and top. I then placed the lengthening bar and pen, or pencil, point in the compass and my makeshift beam-compass was complete. With it I was able to draw an arc of fourteen inches radius, the size of my compass being four and a half inches and the plain dividers four inches.

When drawing very small circles in lead pencil, I found it quite difficult to draw them with my regular compass, and not having a bow pencil, but possessing a bow pen, I got over the difficulty by putting a piece of lead pencil between the nibs of the pen and holding it there by screwing the nibs together. The needle point was then lowered to the proper distance so that with this makeshift I was enabled to draw small circles with tolerable accuracy.

In section lining a common cloth tape measure placed on the drawing board and fastened at the edges with thumb-tacks proved a fair spacer. The triangle is moved one space measured on the top of the tape measure and the section lining will be more evenly done than if judged by the eye alone, although when one has had some practice in section lining it can be done with the eye alone as well as with the above device. For a beginner, however, it will prove a help to get the distances between the lines even.

In drawing a number of circles or arcs from the same center it is best to glue a small piece of paper over the center to hold the point of the compass leg. This will obviate the likelihood of making an unsightly hole in the drawing paper. The best way is to have a supply of these "centers" on hand, which can be made from a piece of waste drawing paper. Spread a thin coating of glue on the paper and when dry it is ready for use, then when needed cut off a small piece, moisten and fasten it to your drawing paper. It can be easily removed from the sheet with the blade of a penknife, and the little glue which remains on the paper can be removed by the application of a rubber ink eraser.

CHARLES G. PEKER.

New York City.

* * *

A SUGGESTION FROM ACROSS THE "POND."

Editor MACHINERY:

Incidentally while remarking that on page 248 of April MACHINERY Mr. Haddix has left the cross-head key D in place while he is toggling the cross-head and piston-rod apart, I beg to protest against the word "back head." The back head of a locomotive cylinder would be the front head of a horizontal stationary engine. Vertical engines have no back heads, while inclined ones would puzzle us all. Perhaps "in" and "out" end or "crank" and "out" end would be more definite.

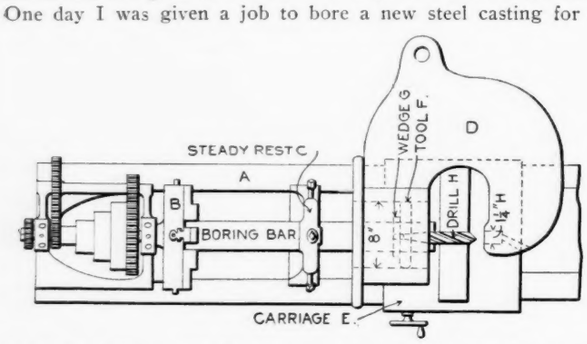
Dresden, Germany. ROBERT GRIMSHAW.

* * *

A BORING JOB.

Editor MACHINERY:

Some time ago I worked in a small shop where there were only six lathes, two planers and some drill presses of medium size. One day I was given a job to bore a new steel casting for a



hydraulic riveting machine, but soon found that the job was far too large to swing in any lathe in the shop and that the drill presses were also too small to handle it.

The inclosed sketch will show how I managed to bore it on an ordinary lathe. The casting D was bolted on the top of the carriage E and centrally located by a small boring bar held in the chuck. A piece of four-inch shafting was then bored on another lathe to the Morse taper for twist drills and a slot was cut, as shown in the sketch for the cutter F and the wedge G. When the boring bar was ready I chucked one end and near the other end placed the steady-rest C, leaving room for the required travel of the carriage and casting. The large hole was then bored to within 1-16" of the required diameter with the cutter in place, as shown, and then the twist drill was put into its socket and the hole H drilled for the die. After the hole was drilled to the required diameter, it was finished with a rose reamer and then the finishing cut taken in the large hole I. After facing the flange the job was done and it was a very good one, too. On such work the steady-rest must be strong and stiff to give good results.

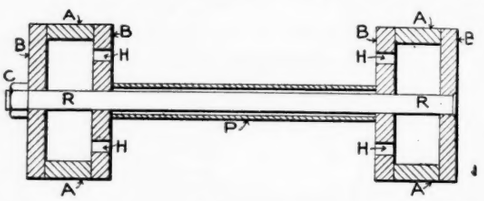
SUBSCRIBER.

* * *

A NOVEL FORM OF FLUE PLUG.

Editor MACHINERY:

We have been troubled at times by the tubes of a Scotch marine boiler, 12′ x 12′, giving out and were not able to use the patent stopper on account of the restricted space in the boiler room. The vessel has only one boiler and that is so located that a beam runs in front of the boiler connection doors which prevents them being opened far enough to get one of the long stoppers in and we could not use a short one if the leak were in the middle of the tube, as there is not room to use a wrench.



The engineer who preceded me in charge of the boiler made a practice of using short tapered cast-iron plugs which were driven in at each end of the leaking tube, but that necessitated the partial hauling of the fire so that a man could go into the back connection to put in the plug. The hauling of the fire requires the stopping of the ship, which is a serious and often dangerous matter.

I tried to find some form of stopper that could be used satisfactorily under these circumstances, but could not, so with some assistance, I succeeded in making one which worked well and hope it may be of some use to the readers of MACHINERY.

The sketch shows the device clearly and shows that it consists of the four washers B B B B and the piece of pipe P, held together by the bolt R. Between the washers are the rubber rings A A and through the inner washers are drilled the holes H H H H, which are for the admission of steam to the under side of the rubber rings. To stop a leak in a tube the stopper, which is adjusted to slip through the tube easily, is pushed in until the end of the stopper is beyond the leak when the steam enters the space between the washers, enters the holes H H H H and swells the rubber packing out tightly against the inside of the tube and stops the leak. It will be seen that it is perfectly automatic and that there is no tendency for the plug to blow out.

San Francisco, Cal. G. W. B.

* * *

THE COUNTRY JOB SHOP.

Editor MACHINERY:

I am a reader of MACHINERY and enjoy reading it very much. I wish to call your attention to Mr. Clough's idea of the country job shop. He said the class of work must concern plows, mowers, etc., but I wish to tell him that the country job shop never sees a plow and hardly ever a mower, but I will try and tell him what class of work the man in the country job shop does and what he is expected to do. Mr. Clough does not seem to know as he probably has not had any experience further than with lathe or planer hands. The man in the country job shop does the most difficult repair work. He can make repairs on any part of the steam engine or boiler and is also capable of building engines or machine tools and other machinery. Mr. Clough says "We had our experience where good work and good tools were our fortune." He probably refers to those "white-shirt machinists" that can't do a good job of work without a special tool for each job. The country job shop can do good work on old tools if need be.

L. COTTINGHAM,

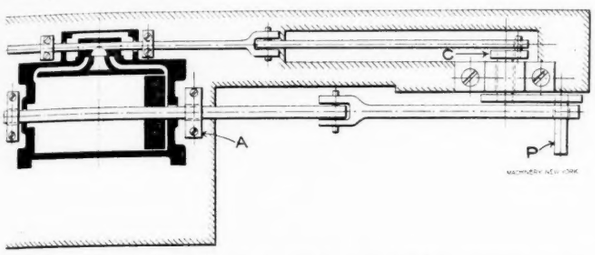
Delta, Ohio. Proprietor of a Country Job Shop.

A VALVE MOTION MODEL.

Editor MACHINERY:

To those interested in the study of the slide valve, an assembled model of the steam chest, cylinder, valve, piston, crank and connecting rods, as shown in the illustration, is a very instructive arrangement for the student and a very simple thing to make.

A piece of stiff drawing paper is cut out the shape as shown along the hatched lines, and pasted to a piece of thin wood. The cylinder and steam chest are outlined and sectioned in solid. The piston rod and valve stem are cut out of wood and allowed to extend through the cylinder and steam chest respectively, and are steadied by the blocks A, which may either be screwed down or glued. The piston and valve are cut out of paper and pasted to their respective rods, care being taken to place them correctly, allowing the piston to have a slight clearance between it and the inside of the cylinder head, for back pressure clearance, when the piston is at the end of its travel.



The main crank bearing is made in a similar manner to the blocks A, except that the hole for the crank shaft is made round instead of square. A common spool with the ends sawed off and flattened on one side, and fastened down with a bent strip of tin or glued as before, may be employed for this purpose. Instead of an eccentric, a small crank C is used which is made a trifle loose on the crank shaft, for the adjusting of the valve position. The crank pin is allowed to project far enough to serve as a handle for manipulating the whole arrangement.

With this simple device the student and even engineers may be able to locate the position of the piston for any setting of the valve; the time cut-off occurs; the result of too much or too little lap or lead, etc.

GEO. H. WALTMAN.

Hokendauqua, Pa.

* * *

BROKEN GEARS—INDEXING—TROUBLE WITH CHIPS.

Editor MACHINERY:

While the method adopted by "Win" is often resorted to, I think a more satisfactory way to repair a broken gear is to dovetail and rivet a piece into the gear large enough to supply the missing teeth, as shown in Fig. 1. A good template can be made out of cardboard and the teeth shaped to it.

The difficulty with the screwed or pinned teeth is that they work loose and also wear hollow places in the opposing gear. With a hack-saw, file and hammer a tooth can be fitted in a gear like that shown in Fig. 3 in a very short time by using the hack-saw to cut the slot in the gear. The slot is filed slightly tapering and is recessed at each end for riveting. The piece to be fitted in the slot is worked down to the dovetail shape, but should not be riveted into the gear as the spaces are too narrow on the sides to admit of filing the tooth to shape. It should be roughed out in the vise, as shown in Fig. 4, so that when it is riveted in place it will not require much filing. Use a fine file to dress off the part that is riveted and finish with emery cloth. I have put teeth in gears in this way so perfectly that an expert could hardly detect them.

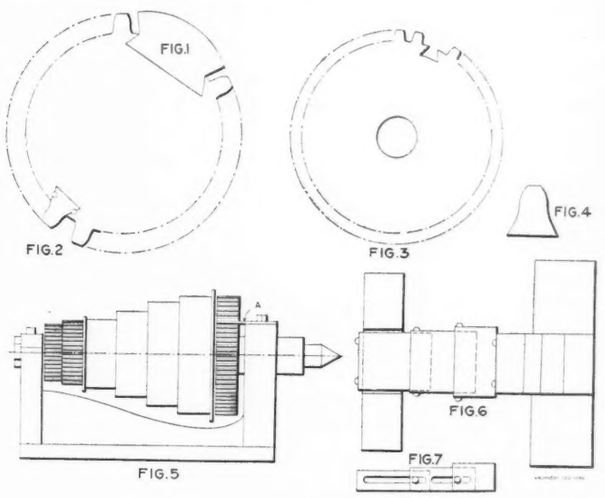
Of course a shaper is better adapted to this work, but where the machine is not available I believe that this is the next best way.

Some gears cannot be cut clear across the face on account of a flange or shoulder and others are so placed against the hub of a larger pulley or gear and keyed on so tight that to remove them means their destruction. To repair them it is necessary to use the hammer and chisel to cut the slot. After fitting in the tooth, drill two holes, as shown in Fig. 2, so that one-half the hole is in the inserted tooth and the other half in the gear, then tap and screw into them two pieces of threaded rod. After putting the finishing touches to the shape of the teeth they are ready for business.

I have seen insterted teeth like those in Fig. 1, 2 and 3 that have been running for over five years and doing good service without getting loose.

In some country shops where indexing heads are almost unknown there are times when the necessity of a substitute makes the owner forget his cabbages and potatoes and look around for something that will enable him to make divisions with accuracy. However, we will have to go no farther into the country than Jersey City to find a case where the need of a substitute caused a friend to ask for some help. He had to make something like a reamer with six flutes and wanted to get equal divisions. He tried several methods with dividers, but was unable to obtain accurate spacing and came to me for advice. I made a sketch like that shown in Fig. 5, which shows a simple method of using the face gear of his lathe for an index wheel. The piece A is made from flat iron or steel with a hole for the cap screw of the front bearing. The end fits in the tooth space and the gear can be held rigidly in place by tightening the cap screw with the strip engaged with the teeth of the gear.

The piece to be graduated is placed between the centers and clamped firmly to the face-plate, then with the pointer in the tooth space a line is scratched on the work by a sharp tool in the tool-post. My friend's lathe had 72 teeth in the face gear so that it was only necessary to count off twelve teeth between each line to get the six required divisions.



With all our modern efficiency in tool making, there is one part neglected by nearly all designers, that is to protect the cross feed screw and slide for the tool block of a lathe. While the makers are puzzling their brains about reducing the limit of error in their machines they hardly ever give this much-abused part a thought.

If they could only see the outcome of their neglect, the screw channel choked up with chips and underneath the screw packed so tightly that the chips raise the screw out of its line, giving the operator the impression that he has the slide rest for the block a little too tight, and so loosens up a bit with a consequent result that is easily imagined. The chips also follow the screw when in motion and drop into the apron. I have seen gears in the apron which I first supposed were pinned, but on closer inspection found chips (that had worked their way from the unprotected channel) wedged in the teeth and they had certainly left a good impression on their neighbors. This neglect does not apply to lathes alone, as any one who has run a slotter will tell you. It has been my good fortune to have machines, from the oakbed and chain feed lathes to the modern patent thread cutting machines. If I had been looking for a lathe or any other machine with protected feed screws I would have been disappointed. Fig. 7 is a sketch I gave to a man in trouble with a choked channel, and as will be seen from the sketch it is a telescoping shield fastened to end of the tool block and also fastened to the outside end of the carriage with pins and slots on the side. It may not be perfect, but it will keep out the chips.

F. B. C.

SHOP KINKS.

A DEPARTMENT OF PRACTICAL IDEAS FOR THE SHOP. Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary.

AN INSIDE CALIPER.

Mr. A. L. Graffam while in Canada some months ago ran across the inside caliper illustrated in the cut, Fig. 1, which is the design of Mr. Temple, of Hamilton, Ontario, Can. It was constructed for taking the size of recessed cavities similar to an eccentric strap and consists of a measuring point jointed to one end of a small pipe. The pipe has a rod C that carries another

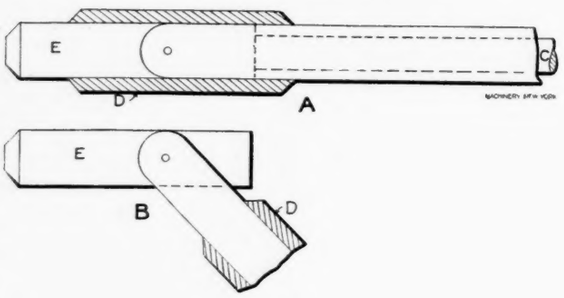


FIG. 1.

measuring point and the pipe and rod can be locked at any intermediate point between the extremes. The closely fitted sleeve D has a slightly tapered hole and can be slid back, as shown at B, so that the tool can be doubled up for removal from the cavity being calipered. After being removed the point is straightened out and locked in place without losing the measurement.

AN ADJUSTABLE PRICK PUNCH.

"J. R. S.," of Toronto Junction, Canada, sends a sketch of a tool that is convenient for spacing prick marks at equi-distant points, and it is said to be specially valuable on die work. On the latter work it is used for laying off holes for blocking out cutting dies and the strippers for the same. Where a number of holes are to be drilled at a given distance from center to

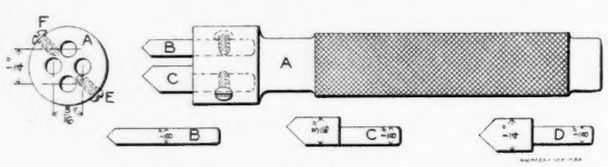


FIG. 2

center, and the distance comes within the capacity of the tool, the holes can be more accurately and quickly located than when dividers are used. One pair of holes in the punch holder A, Fig. 2, are drilled 3-16" and the other pair ¼" from center to center. This feature together with the fact that the punches are on an eccentric gives an adjustment from ⅛" to 5-16". The same adjustment can be used for drills double the size indicated by the punch by using the alternate prick marks instead of every one.

USING WIRE FOR A REAMER.

A correspondent from Indian Orchard says that at one time he had some sheet steel to drill for riveting and could find no drill of the right size, all those in stock being either too large or too small. A friend suggested that a section of Stub's steel

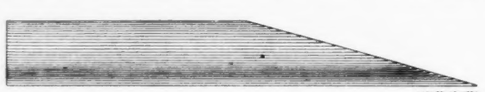


FIG. 3.

wire be hardened and ground off to the shape shown in Fig. 3, and used as a reamer to enlarge the hole after it had been drilled with a smaller sized drill. He says that it was tried and that it worked successfully, but we think that it would have been a better scheme to have made a flat drill of the correct size instead of the reamer and thus save one operation.

A SUBSTITUTE FOR A PIPE CENTER.

The device shown in Fig. 4 is made from sheet steel, which is cut with the three equi-distant arms C, C, C, having the ends bent at right angles and tapped for the screws B, B, B. A small hole is drilled through the center and countersunk for the lathe center. It is to be used instead of the ordinary pipe center, the screws being set up against the inside of the pipe and adjusted the same as chuck jaws would be.

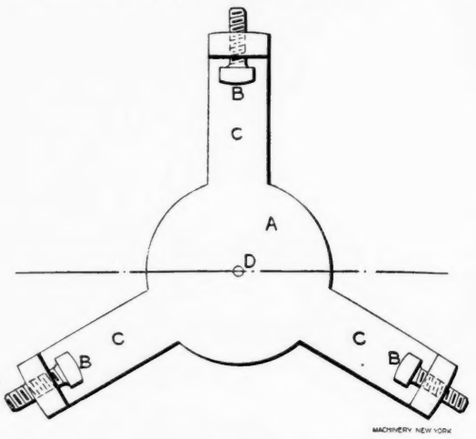


FIG. 4.

"G," who sends the above kink, says that cast-iron will take a better polish if it be rubbed with a piece of grindstone before the emery cloth is applied. To give cast-iron a silver like polish, use water instead of oil on the emery cloth, or if there be any scratches in the work use oil first and then finish with water.

AN IMPROVISED LATHE DOG.

Mr. B. F. Grout, of Springfield, Vt., says that a good way to hold studs or pieces that are to be threaded at both ends when you have no special dog, is to take a thick nut and file or grind off the corners and to saw it nearly in two lengthwise with the thread, leaving just enough metal to hold the two parts together. Then screw the nut on the end of the stud and put on a common dog, as shown in the sketch, Fig. 5.

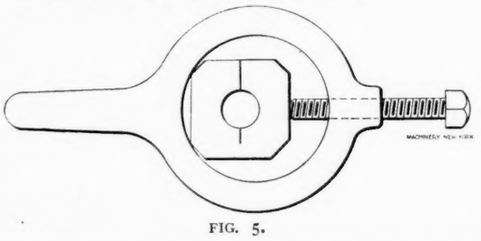


FIG. 5.

Another kink is to have a little black lead or plumbago mixed to a thick paste and when you use the hack-saw take a pinch and smear the saw blade with it nearly to the teeth.

You will be surprised by the result as the saw will last longer and run easier.

RIG FOR HOLDING DRILL.

Mr. Geo. H. Norris, of Poughkeepsie, N. Y., says that it is somewhat risky to drill holes in the lathe as there is always danger of the drill drawing off the center when it begins to go through the work. Men are sometimes hurt in this way and many drills are broken, besides damaging the work. The simple

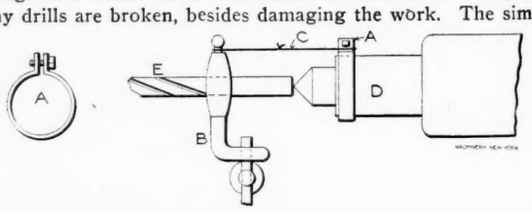


FIG. 6.

rig shown in Fig. 6 obviates all this trouble, and it may be the means of saving some fellow workman considerable damage to his morals and fingers.

The clamp A is made about ⅝" or ¾" wide, 3-16" thick and of the proper diameter to grasp the tail stock spindle. The sketch shows the method of using it clearly, the dog on the drill being held to the point of the lathe center by the piece of belt lacing C.

RIG FOR MAKING SPECIAL KNURLS.

The job of making a knurl in an ordinary lathe by the intersection of right and left parallel threads, while possible, is one attended with trouble and is not likely to always prove successful. The method illustrated in Fig. 7 shows an interesting scheme for doing such work in an ordinary lathe by the aid of index centers and the other attachments shown. The index centers C have a bracket F bolted near the end, which has a center hole drilled in line with the spindle in the index head.

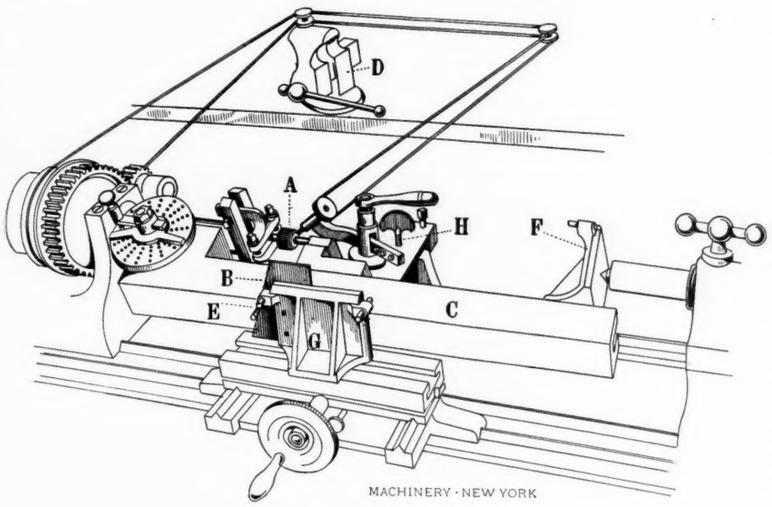


FIG. 7

The bracket G is fastened to the top of the cross-slide of the carriage near the front and a piece of sheet steel B is screwed to it, which is cut off at an angle as indicated in the sketch. The pin E, which is a part of C, slides along the incline and thereby gives a longitudinal movement to the tool carriage. The frame C is swung on the lathe centers and the carriage is held to the pin E by a weight, cord and pulley, not shown in the cut. The piece H, which is held in the tool-post, carries a spindle driven by the small sheave. There is a small milling cutter of about 60° angle mounted on the lower end of the spindle which is driven by the cord running over the sheave and around the idlers to the cone pulley. A wooden handle, not shown, is clamped to the frame of the index centers to enable the operator to swing them up and down.

In operation a cut on the knurl A is set by the cross-feed screw of the carriage and then the index centers are swung by the handle until the end of the cut is reached and then the knurl is turned around one space by the dial plate for another cut and so on until all the cuts are finished. The steel plate B is turned upside down when the cuts are made in a left-hand direction so that the right-hand ones may then be cut.

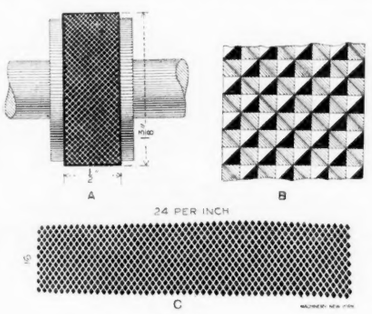


FIG. 8.

In shaping the plate B, the edge is considered as being a section of screw thread having a radius equal to the distance from B to the line of the centers and a pitch equal to the distance that would be measured by the pitch of the knurl. Thus if the diameter of the knurl is one inch and the cuts have an inclination of forty-five to the axis, the pitch for a complete turn would be equal to 3.1416". Therefore the vertical travel of the pin E is to the longitudinal travel of the cutter as the distance from B to the center, is to the radius of the knurl. Hence to cut a knurl of 3/8" face, the index centers would have to swing through about one-eighth of a circle, and if the distance from B to the centers were 7", the inclination of B from a vertical line would be 3/8" in a height of 5½".

Fig. 8 shows a finished knurl, B the cuts greatly enlarged and C work knurled by it.

Mr. James P. Hayes, of Meriden, Conn., sent the description and sketches of this rig and says that it is quite rapid and effective.

A PLANER TOOL HOLDER.

A small shop in Newark, N. J., posseses a tool holder for planer use that has some points of merit, as will be seen from the sketch below, in Fig. 9. The holder consists of a steel bar, E, about two inches square in the shank, but enlarged at the lower end for the tool-post A. The hole or eye has two diameters, as indicated in the sectional cut, and the shoulder F forms an abutment for the piece C that takes the thrust of the set-screw D. When the screw D is set up, the tool-post is drawn through the holder against the tool B, which can thus be clamped solidly in any position. It will be seen that the point of the screw does not come in contact with the tool and thereby saves it from being scored by the point, but the principal superiority seems to be in the ease with which the adjustment of the tool can be made. There is no interference when the operator wishes to change a tool or the angle at which it is set as he grasps the tool with one hand and loosens the screw with the other which comes on the opposite side of the holder, making the operation free from the somewhat awkward action that takes place when the set-screw is on the same side as the tool. The holder from which this sketch was made had a shank nearly two feet long, thus enabling small tools to be used at a considerable reach.

FINISHING CUP LEATHERS.

A western correspondent writes:

I notice in the April issue that H. T. M. asks in Question No. 84 about methods for finishing cup leathers, and possibly the brief description of the manner in which they are finished in one

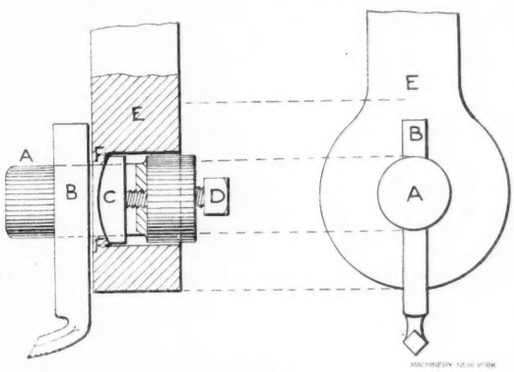


FIG. 9.

of the large tool manufacturing shops may be of interest to your readers.

After the cup leathers have been removed from the mold and are dry enough to hold their shape they are taken to the pattern shop and a wooden chuck is turned out suitable for holding them. The leathers are placed therein and the chamfered edge is turned on them in a pattern-maker's lathe, the operation requiring a small amount of time. The accompanying sketch will explain the method fully.

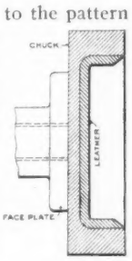


FIG. 10.

In a later letter the correspondent says that upon investigation it was found that the method had been given up on account of the impossibility of keeping the leather up to the tool so that a sharp edge would be turned.

It seems that this difficulty could be overcome by proper manipulation, and we should be pleased to hear from some of the readers of MACHINERY who have had any experience in making cup leathers in this manner.

* * *

Have these shop kinks interested you? Why not send one yourself to interest others?

ITEMS OF MECHANICAL INTEREST

NOTES GLEANED FROM OUR CONTEMPORARIES.

TOOLS FOR BURNISHING JOURNALS.

It is only seven or eight years since roller burnishers were first used in locomotive shops for finishing the bearing surfaces of axles, crank-pins, piston-rods, etc., but so popular has the practice proved that there is scarcely a railroad repair shop of any pretensions throughout the country but is using this useful tool in some form instead of the time-honored file and emery cloth. An axle bearing after being turned in the lathe is comparatively true and round, but the slight inequalities on the surface must be removed before it will run in the bearing satisfactorily. If the journal be filed, the slight inequalities are removed at the expense of accuracy as no filed surface can ever be perfectly round. The result of bearings finished in this manner is that a number of days have to be devoted to "breaking in" a locomotive when it leaves the repair shop before it is fit for road service. This "breaking in" process simply means that the surface of the bearing is being worn to the condition required for cool running. If this condition can be approximated at the start, it is obvious that a considerable gain will be made in the life of the bearing besides saving valuable time in getting the machinery into working condition. The roller burnishing tool is admirably adapted to this result, as intimated by the fact of its almost immediate popularity in railroad shops which are usually very conservative in regard to innovations.

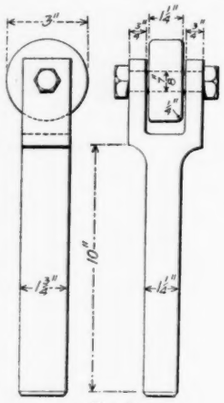


Fig. 1.

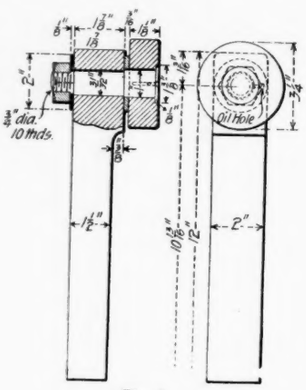
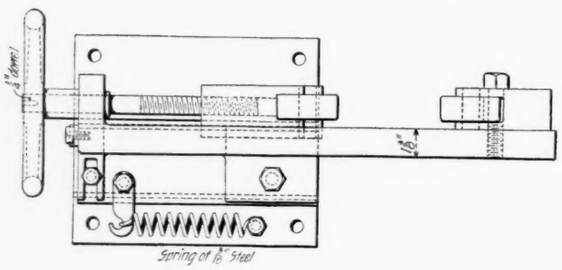


Fig. 2



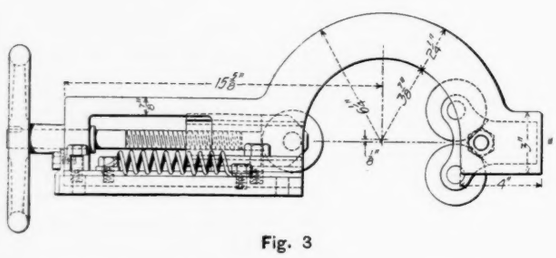


Fig. 3

We illustrate herewith three forms of burnishers which were part of an article on these tools in a recent number of the "American Engineer and Railroad Journal." The tool shown by Fig. 1 is the common form having a hardened steel roller turning on a bushed bolt through the forked part. The shank is made of convenient size to enter the tool-post and the roller is screwed up against the revolving work giving it practically a cold rolled surface that is true and in the best possible condition for cool running.

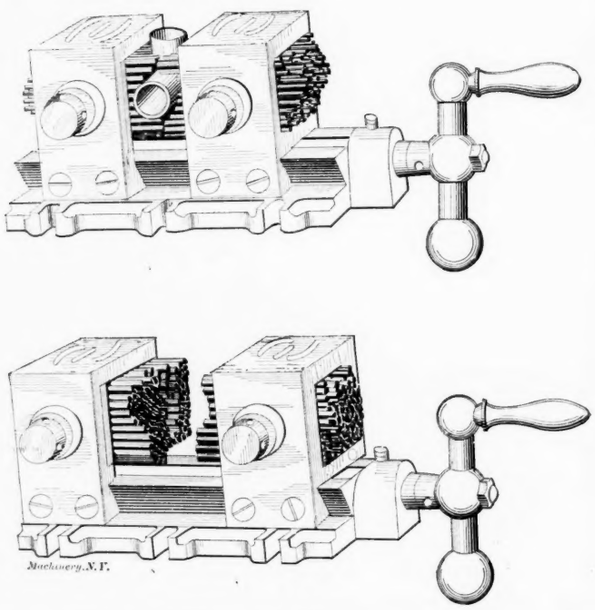
Fig. 2 is another form which is useful for getting up close to shoulders or collars like those on a crank-pin and can be used either side up, thus making it either a right or left-hand tool. As it is necessary to have a heavy pressure on the roller in order to get the best result, it follows that work of this character is rather hard on a lathe and to overcome this objection the form of burnisher illustrated in Fig. 3, which carries three rollers arranged as shown is considerably used. By this arrangement the centers are relieved of the heavy strain and the rolling of slender work, such as valve stems, etc., is perfectly feasible. Piston-rods and valve stems rolled in this manner present a hard and smooth surface that is peculiarly adapted to the wants of metallic packing. As is well known this form of packing requires considerable nursing on the start, and if not carefully treated, it is easily ruined when applied to the ordinary turned rods which have been smoothed with the file and emery cloth. With the rolled rods, however, the trouble in this direction is reduced to minimum, as the rod quickly acquires the highly polished condition necessary for satisfactory operation.

The use of these tools is not limited to the lathe as the form shown in Figs. 1 and 2 is being used in some shops for rolling the working surfaces of shoes and driving boxes and is said to be peculiarly adapted to burnishing plane surfaces of cast steel.

* * *

AN AUTOMATIC JIG VISE.

A novel form of vise was illustrated in a recent number of the London "Engineer," which appears to have some points of merit, though it is likely that the design would be materially modified if used to any extent in this country. In the description it is stated that some of the most expensive work that a manufacturer has to undertake is the construction of jigs, rigs and chucks for holding irregularly shaped pieces of work for machinery, or occasionally for hand work. Where a large number of similar articles has to be made, of course it pays to go to some expense in this direction, but where only a few are required the cost is considerably increased by the outlay on the chucks required. With a view to meeting this difficulty and removing the necessity of constructing a new set of jigs for every new set of patterns, Mr.



E. H. Jones has invented the ingenious vise illustrated by the annexed cuts. As will be seen, the type shown is intended principally for bolting to the table of a drilling machine, but other forms suitable for a lathe chuck vise are made. The vise consists of two frames or boxes which slide on a well proportioned rest, and are moved by a right and left-hand screw rotated by a handle. Each box is completely filled with a large number of small hexagon mild steel pins, the ends of which are reduced so as to leave a shoulder, and to act as a guide. On each one there fits a small spiral spring, which, by pressing against the shoulder

of the hexagonal part, and against a back plate through which the shanks pass, drives the pin forward. On account of their shape the pins all pack together into the box or frame like a honeycomb. In each box there is a clamping plate and screw. The manner of using the vise is as follows: If it be desired to drill out such a piece as one of the steel tees or elbows used in bicycle construction, a cleaned-up but unmachined casting of one is taken, and is driven fairly tightly on to a drill or spindle fixed in the drilling machine. The vise is then brought into position under it, the clamping screws loosened, and the handle turned, so that the casting is pressed between the jaws. It is evident that an impress of each half of the casting will be left on the flexible faces of the vise, some of the bars projecting further than others, according to the shape of the piece, and if the jaws are then clamped up while the piece is in position a rigid mould will be left, and a jig formed with little trouble and in little time.

* * *

PRACTICAL PROBLEMS.—9.

PROBLEMS 17 AND 18 WITH ANSWERS TO 15 AND 16.

Problem 17.—To Calculate the Efficiency of a Screw.

The screw M in the accompanying sketch is 1½" in diameter and has right and left-hand threads of ¼" pitch working in the nuts E and D. The threads are square and have a mean diameter of 1⅜", that is the circumference of the working face of the screw is to be calculated from this diameter. The nuts through which the screw works are of sufficient length so that with the screws well lubricated we can assume the co-efficient of friction to be .08. With any ordinary working load what should be the efficiency of the screw?

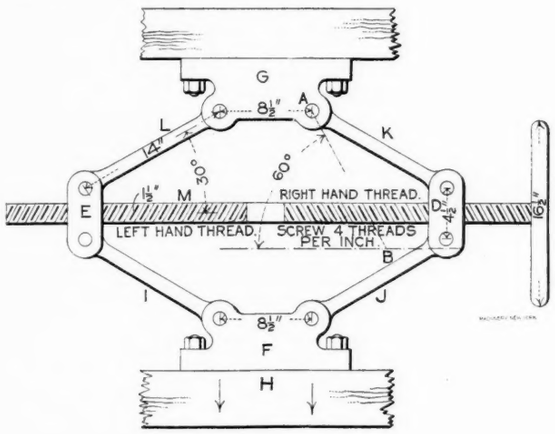


FIG. 1.

Problem 18.—To Find the Pressure Exerted by a Toggle-joint Press with Two Positions of the Arms.

The sketch illustrates the essential features of a press that is manufactured for a variety of purposes such as baling cotton, straw and for pressing wine from grapes, etc. The design is very efficient as by the principle of the toggle-joint the pressure applied increases as the platen lowers when the power applied to the wheel C remains constant. This is of course the correct principle as the resistance of the material operated on usually increases rapidly with the degree of the compression.

Referring to the sketch L, K, I and J are arms of equal length pivoted as shown, in the blocks G and F and also in the nuts E and D. The platen of the press is held in position by vertical guides not shown. The arms in the position indicated by the sketch are inclined to the axis of the screw 30° and another position is shown by the dotted lines in which the angle is 60°. What is the theoretical pressure that would be exerted on the platen with the arms in the first position when the turning force on the periphery of the wheel is sixty pounds? What is it in the second position with the same turning moment on the wheel C? The efficiency of the screw is the result obtained from Problem 17 and friction in the joints of the arms may be disregarded.

ANSWERS TO PREVIOUS PROBLEMS.

An answer to Problem 13 was received from C. Albert Wettengel, of Pittsburg, Kansas, which although not exactly correct was quite a close approximation. Mr. Wettengel's error was that no account was taken of the velocity of translation which modifies the result as shown in the answers published last month.

Mr. Frank L. Wettengel, of St. Louis, Mo., sent a correct solution to Problem 14, but as the solution published covers the ground it is not given.

Problem 15.—In answer to this practical example Mr. A. E. Beals, of Watertown, N. Y., says:

Having once had occasion to use the expedient mentioned in Problem 15 I submit the following solution:

Let X = number of teeth in driving gear attached to the ratchet

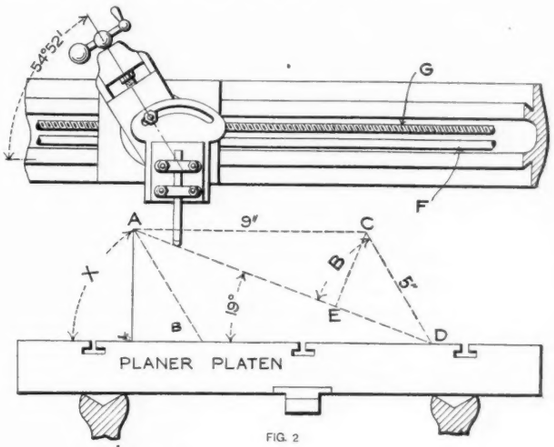


FIG. 2.

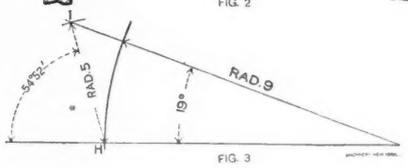


FIG. 3.

feed. Then $\frac{4}{15} \times \frac{1}{6} = \frac{4}{90}$ inches of down feed per rotation of driving gear, and $\frac{4}{20} \times \frac{2}{25} = \frac{4}{50}$ inches of cross feed per rotation of driving gear $\frac{4}{50} \div \frac{4}{90} = \frac{9}{5}$ ratio of cross feed to down feed.

By constructing the "parallelogram of speeds" A, B, C, D, upon the predetermined "resultant," A D, making an angle of 19° with the bed and calling the angle of the head with the bed X we may use the following trigonometrical solution to find the value of angle X.

$$\text{Sin. } B = \frac{9 \times \text{sin. } 19^\circ}{5} = \frac{9 \times .32557}{5} = .58602$$

$\therefore$ B = 35° 52'.

Angle X = 19° + B = 54° 52'.

X being the angle between the bed and head, the head must be swiveled 35° 8' from the perpendicular.

The problem may be solved graphically after determining the ratio of cross feed to down feed by simply laying down the angle of 19° and from the vertex describing an arc with radius equal to 9 cutting the horizontal base line, Fig. 3. Then from this intersection H, describe an arc with radius equal to 5 cutting the 19° line at I. The line I H passing through these intersections will make the required angle of the head from the perpendicular line.

Problem 15.—Mr. James P. Hayes, of Meriden, Conn., sends the accompanying sketch and solution of the combination of cross and down feeds to obtain the angle of 19°.

The splined cross shaft would turn 1 1-3 times as fast as the cross feed screw since the gears are to each other as 20 to 15. In one inch of movement of the saddle on the cross rail, the cross feed screw turns 2½ times, therefore the down feed screw would turn 1 1-3 times 2½ = 3 1-3 turns. The down feed screw having 6 threads per inch, the tool will be moved by the down feed 3½ times 1-6" = 5-9" or .555" with a horizontal movement of one inch for the saddle. The distance A in Figs. 4 and 5 is the travel of the saddle for 2½ turns of the screw and B is the distance the down feed has moved the tool. The sine of the angle C E D or 19° is .325 and if the radius is 1" the length of the line C D is .325", which is also the sine of the angle C F D. 1 ÷ .555 = 1.8, .325 × 1.8 = .586" the length of the sine for an angle equal to C F D with a radius of 1". The equivalent angle as given in the

tables is 35° 54′, which added to 19° gives 55° nearly, the position for the swinging head.

Fig. 5 is a solution of the 20° angle proposition and the swinging head is set the opposite way, as shown. There are two correct answers for each angle, as shown by the following:

By the same method the angle C F D is found to be 38° 3′ from which 20° are to be subtracted for obvious reasons. This leaves 18° for the angle required of the swinging head from the horizontal.

[It is evident from the conditions of the problem that the latter solution is barred, as had it been possible to have set the head at the angle shown in Fig. 5, it would not have been necessary to have resorted to the combination of feeds.]

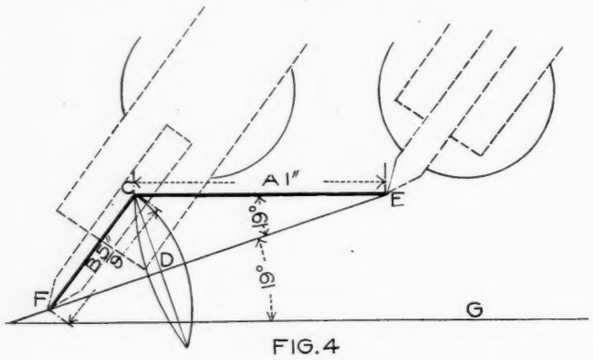


FIG. 4

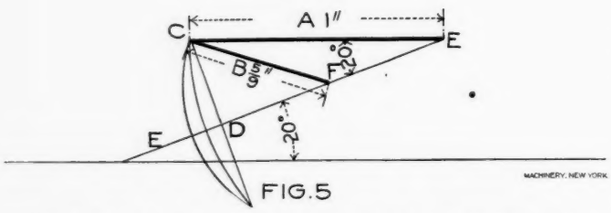


FIG. 5

Problem 16.—"Technical," Ithaca, N. Y., says that the ball A, Fig. 6, has a motion of transition along the line K L, which is the instantaneous center of rotation so that to calculate the travel it is necessary to find how far the line K L is from the center of the ball A. According to the conditions of the problem the sides D E and F G each make an angle of 135° wth the line E F, so if O P be drawn parallel to E F and tangent to the circle, the angle K O P will also be equal to 135°. Since an exterior angle

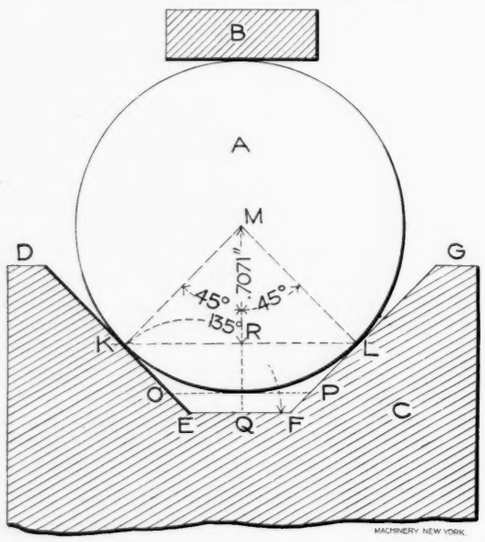


FIG. 6.

subtends an interior angle that is equal to the difference between two right angles and the exterior angle, the angle K M Q equals $180° - 135° = 45°$. Angle Q M L must equal Q M K since by the conditions of the problem the exterior angle is equal to that of O M K. K M L is an isoscles triangle since the sides K M and M L are equal, therefore M Q is perpendicular to the base K L because it bisects the angle K M L. From the fact that the angles of any triangle are always equal to two right angles, we know that angle M K R is equal to 45° as it is the difference between 180° and 45° + 90°. We can now find the length of the side M R from the principles of right angled triangles.

$$\overline{K\,M}^2 = \overline{K\,R}^2 + \overline{M\,R}^2$$

Since the diameter of the ball is 2″, the radius equals 1″, which is therefore the length of K M and as M R and K R are equal, being opposite equal angles, it follows that either K R or M R is equal to $\sqrt{\frac{1}{2}}$.

$$\text{Hence } M\,R = \sqrt{\tfrac{1}{2}}$$
$$M\,R = .7071$$

Therefore the instantaneous center of rotation is .7071″ from the center of the ball which gives the necessary data for computing the relative travel of A and B.

When a ball is rolled between two plane surfaces at opposite ends of a diameter, the relative travel of the movable plane and the center of the ball is expressed by the ratio of the diameter and the radius or as 2:1, but in this case the working diameter must be taken as .7071 + 1 or 1.7071 and the radius as .7071. Hence the ratio of the travel of B and the center of A is 1.7071:.7071:: x : 10 or .7071x = 17.701. x = 24.14″ the travel of B for 10″ travel of the center of A.

[From this problem it is seen that the higher the sides of the groove come up on A, the greater the travel of B to A, and when the sides D E and F G become parallel and therefore tangent to the diameter, the ball would have no progressive motion at all, but would spin on its axis.

It may be well to state for the benefit of some of the readers of MACHINERY that in geometrical problems of this kind, a great circle of the sphere is taken and treated exactly the same as if it were a plane circle. Some may have considered that the problem involved the use of the third dimension, but such is not the case.]

* * *

SOLID REVERSIBLE JAWS FOR GEARED SCROLL CHUCKS.

The nuisance and vexation of having two sets of jaws for scroll chucks is well understood by shopmen as the set of jaws wanted is usually, with the perversity that seems to possess things inanimate, among the missing either as a whole or in part.

Some manufacturers have tried to overcome this trouble by making the jaw in two parts so that the outer or jaw part could be reversed on the inner part that engages the scroll. This construction, while an improvement on the two sets of jaws, is open to the objection that the jaws are necessarily weaker than the solid type and the screws holding the two parts together are liable to be lost or mislaid in making the change.

The Hoggson & Pettis Manufacturing Co., the makers of the well known Sweetland chuck, have recently brought out the style of jaw shown in the cut which overcomes the difficulties mentioned very neatly and in such a self-evident manner that the wonder is that it has never been used before. The jaws are made so that the teeth are formed on each side to the inner curve of the scroll with the consequent result that the jaw can be engaged in either position. As the surfaces of the teeth of a jaw and any scroll can only average a line contact, it is evident that practically nothing is lost in strength or durability by this construction while the advantages are manifest.

* * *

It is expected that within a short time there will be a plant in New York City for producing liquid air on a commercial scale. The plant is to be operated by the General Liquid Air and Refrigerating Co., whose offices are in the St. Paul Building, this city, and it is estimated that it will have a capacity of 1,500 gallons of liquid air a day.

HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

Give all details and name and address. The latter are for our own convenience and will not be published.

100. F. M. T. writes: Which has the greatest back-pressure, an engine exhausting into the atmosphere or one exhausting into a smoke-stack, all other conditions being the same, and why?

A. Ordinarily there would be no appreciable difference, unless the exhaust pipe ran into the chimney in such a way as to choke the exhaust. The pressure of the atmosphere is sufficient to support a column of water about 400 inches high, while a good chimney draft would not amount to more than enough reduction in the pressure to equal three-quarters of an inch of water. It will be seen, therefore, that it will really make no difference whether an engine exhausts against atmospheric pressure or against atmospheric pressure with the very slight reduction due to the chimney draught.

101. H. H. writes: Please tell me what changes in valve setting would be necessary in a 20 40 non-condensing Corliss engine cutting off at one-fifth stroke, when changed into a condensing engine.

A. The valve-gear should be set to give a little more compression; otherwise no change is necessary. You understand, of course, that adding a condenser will increase the power of your engine from 15 to 25 per cent. At present you are running with too short a cut-off for the best economy, which shows that the load is not heavy enough for the engine. When running condensing, however, a cut-off at one-fifth stroke will give good economy, but we should not recommend an earlier cut-off. If you wish to add a condenser you should also add enough to the load to keep the cut-off at about this point; otherwise you may be disappointed in the gain in economy realized.

102. L. K. asks: Please give me a little information concerning coal as steam fuel compared to wood and (2), why should poor coal last as long as good coal and give the same result? We used a car-load at seventy cents, which gave the same result—that is, lasted as long—as a car-load that cost $1.50 per ton. The only difference we found was that it took a great deal more work getting out clinkers, etc.

A. (1) In Kent's pocket book it is stated that "it is safe to assume that 2¼ pounds of dry wood are equal to one pound of average quality of soft coal, and that the full value of the same weight of different woods is very nearly the same—that is, that a pound of hickory is worth no more than a pound of pine, assuming both to be dry. It is important that the wood be dry, as each 10 per cent. of water or moisture in the wood will detract about 12 per cent. from its value as fuel."

(2) We cannot well give a satisfactory answer to your second question. Price does not always determine the practical calorific value of coal. It may be, however, that a furnace differently constructed would produce better results with the more expensive coal than the furnace which you now have. For example, if the coal contained a large amount of volatile matter which would simply pass off without being consumed in the ordinary furnace, a brick arch built over the furnace might result in an increased efficiency since it would become heated and so ignite the gases. It is generally possible to make modifications of one sort or another that will suit the furnace to the coal that it is desired to burn. It is quite essential to know the composition or at least the characteristics of the coal and then the best results can be obtained only by experimenting.

103. J. H. writes: I have noticed that when a piece of tin becomes scratched so as to expose the sheet iron underneath the latter becomes rusted, while in the case of galvanized iron it does not rust so easily when the coating is injured. Can you explain why this is so? A. Tin as an element is negative to iron and hence only prevents rusting while the coating protects the iron from the air. After the coating is scratched the rusting or oxidation proceeds faster than as though tin were not present. An important element in galvanizing is zinc which is positive to iron and therefore protects the latter even in places where it has been scratched. This is the superiority of galvanizing over tinning.

104. B. L. E. asks if there is any difference in the expansion of iron and steel with an increase of temperature? 2. How much will a steel railroad rail expand from winter to summer temperature? 3. I have heard it stated that the force of contraction of an iron rad is practically irresistable. In this statement true? A. The coefficient of expansion for iron is .0000067 and for steel it is .0000065 for an increase of temperature equal to one degree Fahrenheit. Thus an iron rod 50″ long would expand in length .0000067 × 50 = .000335″ for each degree of increase in temperature. So if T. were raised from 60° to 860°, the increase of length would equal 800 × .000335 = .268″ or something over 1-4″. 2. The expansion of the rail is found in the same manner by multiplying its length by the coefficient of expansion and the increase of temperature from winter to summer. It is well to take extreme differences in such cases so that the error will be on the safe side and we will assume the extreme temperature of winter to be 30° below zero and that of summer to be 120° above. This gives a difference of 150° so the expansion equals .0000065 × 30 × 150 = .02925′ or .352″. 3. The force of contraction of an iron rod is a definite quantity and can be easily calculated from the following formula, $S = CtE$ in which C is the coefficient of expansion or contraction, t is the difference in degrees of temperature and E is the coefficient of elasticity.

Taking the modulus of elasticity to be 25,000,000, we find that the stress due to a fall in temperature of 100° in a bar having a area of cross-section equal to four square inches is S = .0000067 × 100 × 25,000.000 × 4 = 67,000 pounds.

* * *

FRESH FROM THE PRESS.

A PRIMER OF THE CALCULUS, by E. Sherman Gould, published by D. Van Nostrand Co., 23 Murray and 27 Warren streets, New York. Pocket size, price 50 cents.

This little book presents in a very clear manner the elementary principles of the calculus. The first chapter, for example, tells what differential calculus is and shows clearly what processes are adopted and what assumptions are made to arrive at the results that are possible by the application of the calculus. There are numerous typical examples both in differentiation and integration which are explained so plainly that one who has a good knowledge of algebra can, by a brief study of this little book, get a good idea of the subject. This book is not a text-book and will need to be supplemented by a larger work containing more examples; but it is an excellent introduction to this study and will also serve for the purpose of review to one who wishes to refresh his memory in mathematics.

NOTES ON DESCRIPTIVE GEOMETRY, by Wm. L. Ames, professor of drawing and machine design, Worcester Polytechnic Institute, Worcester, Mass. Third edition. Price, 50 cents. For sale by Mrs. F. T. Burton, Rose Polytechnic Institute, Terre Haute, Ind.

This little work was sent us by Professor John B. Biddle, of Terre Haute, Ind., to whom the author gives credit for the revision of the notes previous to the publication of the third edition. There are two excellent features about this work which should commend it to the use of schools and colleges. First, the third angle of projection is used throughout in accordance with almost universal practice in the drawing room, but in opposition to what has been the practice of most of the colleges. Second, the conciseness of the treatment, which, in a subject like descriptive geometry, is to be desired. There are a large number of practice examples, and it is in working out these with occasional help from the instructor that a student should learn descriptive geometry rather than by studying a great mass of matter. The text of this book contains simple directions for solving the fundamental problems. The student must then apply these principles to the solution of other problems. Were we to criticize the notes we should say that this principle was carried too far in the more difficult parts of the subject, as, for example, in the intersection of surfaces, where a great deal of supplementary instruction would have to be given by the instructor.

MECHANICAL MOVEMENTS, POWERS, DEVICES AND APPLIANCES, by Gardiner D. Hiscox. Published by Norman W. Henley & Co., New York. Contains 402 8vo pages, illustrated by over 1,600 engravings. Price $3.00.

This interesting book will undoubtedly be of considerable value to students, draftsmen, inventors, etc., as the wide range of the devices illustrated and described make it a comprehensive cyclopedia of mechanism.

The work contains eighteen chapters which give appropriate divisions to the work, which are as follows: The mechanical powers, transmission of power, measurement of power, steam power, steam appliances, motive power, hydraulic power and devices, air power appliances, electric power and construction, navigation and roads, gearing, motion and devices for controlling

motion, horological, mining, mill and factory appliances, construction and devices, draughting devices and miscellaneous devices.

PATENTS AND HOW TO MAKE MONEY OUT OF THEM, by Hutchinson & Criswell. Published by D. Van Nostrand & Co., New York; 232 pages. Price $1.25.

This interesting and really valuable work is not published to further the interests of any patent firm, but is a book containing a large amount of advice that will undoubtedly be the means of saving many inventors considerable cash. The status of foreign patents is clearly set forth and although many foreign patents are found to be profitable, the chances are that an ordinary device protected by patent in foreign countries would be an onerous burden to the inventor before it could be made to bring any returns. The wide and profitable field existing in the United States for most devices will usually absorb all the efforts and capital of most inventors before it can be put on a paying basis.

Among other features there is appended a number of legal forms that serve to give the inventor an idea of the language to be used and the specifications to be noted to make such documents of value.

THE July *Century* is a story teller's number, and is novel in its make-up, not only because it has a large amount of original fiction by ten living story writers, but because it contains also articles on seven of the world's most famous makers of fiction, two only of whom are living. In only one or two cases do these articles consist of criticism. In most cases they are new material concerning the writers mentioned. It is an exceptionally good number for summer reading.

AMERICAN ELECTRICAL DIRECTORY of central lighting stations, quarterly issue of March 31, 1899. Published by the E. L. Powers Co., 150 Nassau street, New York; 130 pages, subscription price $4.00 per year.

This directory contains a buyer's finding list, together with a list of electric light central stations with information about the sizes of stations, names of officers, engineers, etc., and population of the towns in which the stations are located.

ADVERTISING LITERATURE.

THE STANDARD SIZES FOR CATALOGS ARE 9 X 12, 6 X 9 AND 3½ X 6 INCHES. THE 6 X 9 IS RECOMMENDED, AS THIS SIZE IS MOST LIKELY TO BE PRESERVED.

THE SAWYER TOOL CO., Fitchburg, Mass. Catalogue C and price list of mechanics' tools and hardware specialties. Sixty-four pages, pocket size, illustrated.

The tools made by the company include a large line of steel rules and squares, surface gauges, bevels, machinists' hammers, levels, calipers and dividers. Among the new tools listed are the screw drivers recently described in these columns. There are also a variety of other tools and the catalogue will be an interesting one for mechanics to procure.

THE CLING-SURFACE MANUFACTURING CO., Buffalo, N. Y., have issued a circular with a report of tests of their preparation made by Prof. R. C. Carpenter, a summary of which was recently given in this paper.

THE B. F. STURTEVANT CO. have sent us a reprint from the Columbia Engineer, Columbia University, New York, of a lecture delivered there by Walter B. Snow, of the engineering staff of the B. F. Sturtevant Co., Boston, Mass., upon the influence of mechanical draft upon the ultimate efficiency of steam boilers. This circular contains a very good presentation of the subject of mechanical draft and may be had upon application.

WM. BARAGWANATH & SON, Chicago, Ill. Catalogue of feed water heaters, purifiers and condensers. Twenty-four pages, illustrated.

In this catalogue are shown several types of steam jacket feed water heaters, plain tubular heaters, horizontal and vertical open heaters, water purifiers and syphon condensers.

THE E. W. BLISS CO., Brooklyn, New York City. Catalogue of presses, dies, shears and special machinery. Sixteen pages, pocket size.

This catalogue contains in condensed form descriptions and illustrations of a variety of power presses for different lines of work, and also of punching machines, shears, drop hammers, etc., and the Bliss-Heath vacuum or atmospheric pumping engine.

AN attractive and striking circular has been issued by Gould & Eberhardt describing Eberhardt's patent automatic sand sifter and mixer.

LEHIGH UNIVERSITY, South Bethlehem, Pa., have sent us a prospectus of the courses to be given at the university during the coming summer. These are not only for the students of the university, but several of them are open to applicants from outside who are duly qualified to take them.

THE D. VAN NOSTRAND CO., 23 Murray street, New York, have published a list of the new books that have lately appeared upon technical subjects.

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MANUFACTURERS' NOTES.

THE B. F. STURTEVANT CO., of Boston, Mass., early recognized the demand for electrically driven fans, which was sure to follow the general distribution of electricity for power purposes. Its first fan motors were built about ten years ago, since which time designs have been perfected, the number of types greatly increased, and a large electrical department established. Some of the recent products of this company in the way of special electric fans are presented in their bulletins H. and M. The former relates to the enclosed fans, the latter to propeller ventilating wheels.

A REPEAT order is one of the best recommendations a manufacturer can have for his product. The Hoppes Manufacturing Co., Springfield, O., report such orders for feed-water heaters and purifiers from seven well-known firms aggregating 8,000 horsepower.

THE volume of business of the Saginaw Manufacturing Co. has increased so much of late, that they have been compelled to almost double their power plant. We are informed by them that their plant will be shut down from June 23 to July 5, for the purpose of installing a new engine, during which time no orders can be executed, except from the stock which is in their warehouse at that time. Their factory and main offices are located at Saginaw, Mich.

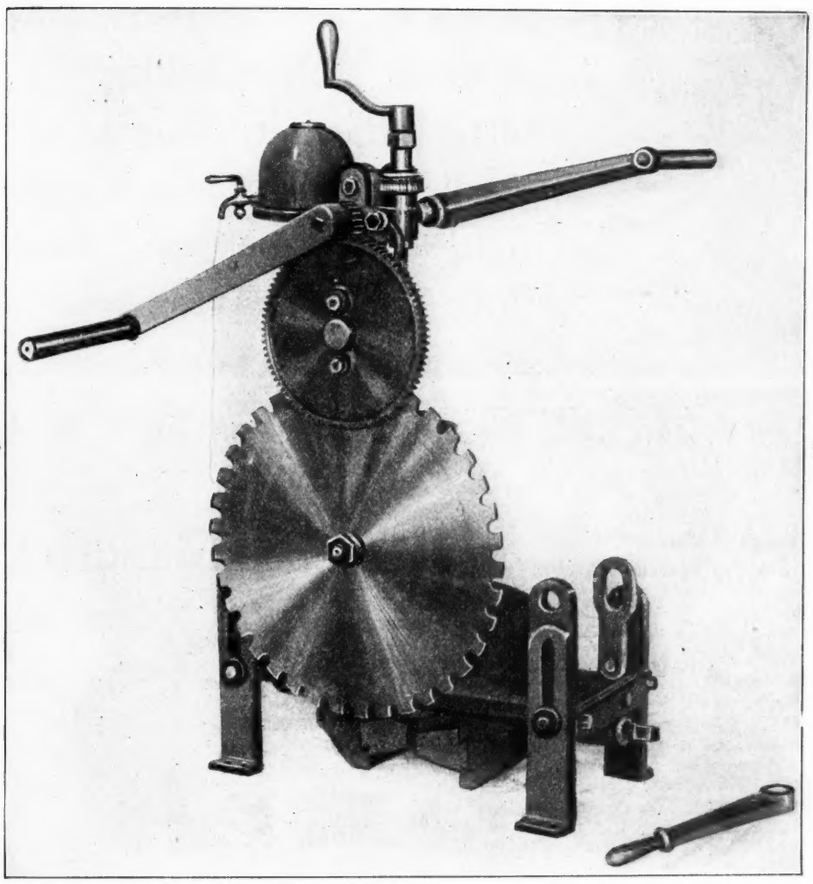
IT is understood that Charles F. Thompson, secretary, treasurer and director of the Lane & Bodley Co., has resigned his position in those capacities to take effect July 1. Mr. Thompson has been with the company thirty-five years. It is not as yet known who will be the successor to Mr. Thompson nor has Mr. Thompson made up his mind as to what he will do in the future.

THE LIDGERWOOD MANUFACTURING CO., New York manufacturers of improved hoisting engines and suspension cableways, have recently established a branch at Atlanta, Ga., with offices in the Prudential Building. This is said to be the finest office building in Atlanta, if not indeed in the entire South. The Atlanta branch will be in charge of Mr. J. H. Dickinson, C. E. sales agent.

THE SCRANTON & CO. have recently appointed J. W. Wright & Co., 811 South Second street, St. Louis, Mo., representatives for the Scranton improved upright power hammers in St. Louis and vicinity.

THE AMERICAN PNEUMATIC TOOL CO., of New York City, report that they have sold to the National Pneumatic Tool Co., of Philadelphia, Pa., the right to manufacture pneumatic tools for use in the metal trades. The National Pneumatic Tool Co. pays a considerable sum for this privilege, which is to be exclusive except as regards the American Pneumatic Tool Co., which will continue to make and sell for all purposes pneumatic tools as heretofore.

Bryant Portable Rail Saw.



Made in two sizes and four styles to cut 100 pound steam rail or 9-inch street rail. Cuts at any angle up to 45 degrees. Attached to rail in place. Automatic feed and easy operation.

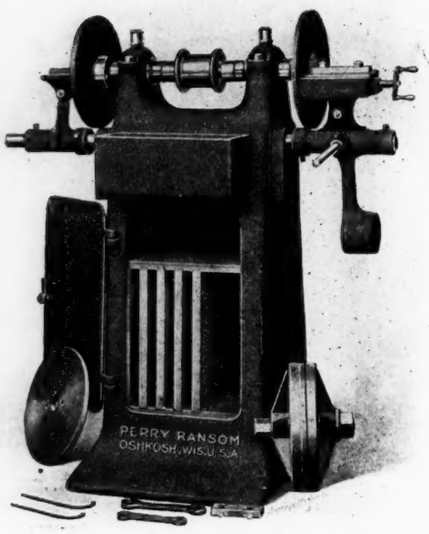
THE Q. & C. COMPANY,

700-712 Western Union Building, Chicago.

106 Liberty Street, New York.
17 Place d'Armes Hill, Montreal.
403 Security Building, St. Louis, Mo.
109 Endicott Arcade, St. Paul.
537 Mission Street, San Francisco.
22 So. 15th Street, Philadelphia.

Don't use a file simply because your Grandfather did. Get a

Vulcan Disc Grinder



It is a well established fact that shafts can be ground cheaper and better than they can be turned to a fit. This is just as true of small flat surfaces. They will grind faster and better than any man could ever file. Made in two sizes, 12 inch and 18 inch. Machine has been improved since this engraving was made.

A full line of Vulcan Grinding and Polishing Machinery.

PATENTS APPLIED FOR.

PERRY RANSOM, Oshkosh, Wisconsin, U. S. A.

W. R. Colcord Machinery Co., St. Louis, Mo. Marshall & Huschart Machinery Co., Chicago and Cleveland. Prentiss Tool & Supply Co., New York City.
V. Lowener, Copenhagen, Denmark.

MANUFACTURERS' NOTES.

THE ARMSTRONG MANUFACTURING CO., of Bridgeport, Conn., have found it necessary to make another addition to their facilities. This is the second increase since January 1st, and much new machinery is now being added to the works. They report an increase of 30 per cent. in their export business during the last few months, and the pipe-fitting machinery which they have shipped to Germany alone is said to be greater than the entire production of that country in their line.

MESSRS. CHAS. H. BESLY & CO., 10 and 12 North Canal street, Chicago, carry the following line of Pecore machinery paints: Flat steel color, egg shell gloss enamel, Dresden machine enamel, iron filler and Pecore blow hole cement.

THE W. F. & JOHN BARNES CO., Rockford, Ill., have just completed an addition to their factory, and are now laying the foundation for still further extension, which will supply the additional room now much needed.

WANTED.—Salesman to handle quick selling line of tools on commission. Address UNION TIRE CO., Plainfield, N. J.

WANTED.—Brown & Sharpe No. 12 Plain Milling Machines. State condition, fittings and price. Address REED MFG. CO., Erie, Pa.

SMALL STEAM ENGINES AND BOILERS.—Castings $2.00 up. Also castings for water motors, gas engines and locomotives. Circulars free. GRANT R. SIPP, Paterson, N. J.

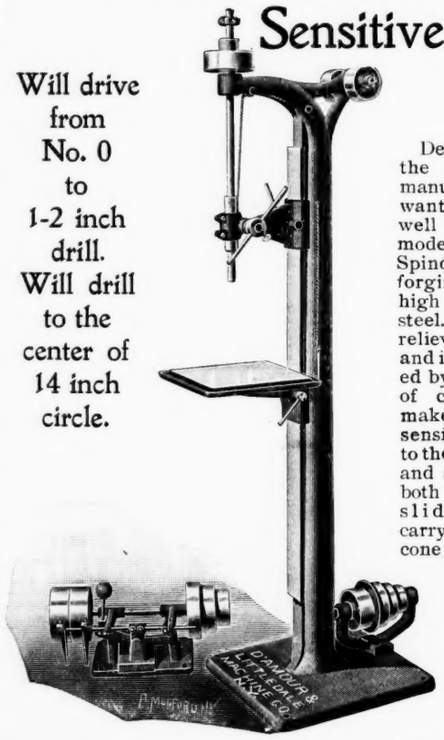
WANTED.—Foreman for the brass department of a manufacturing establishment, to take charge of 20 to 25 men. Must be thoroughly up to date and familar with the making of tools, etc. State age, experience and wages. Address "Foreman," care of MACHINERY, 9-15 Murray Street, New York.

PATENT RIGHT FOR SALE.—The British patent right on a valuable machine tool favorably known and thoroughly introduced throughout the United States. For full particulars please address "MACHINE TOOL," care of MACHINERY, 9-15 Murray Street, New York.

SECOND HAND TOOLS WANTED.—One 30 inch Horizontal Boring Mill; one 24 inch Shaper; one Iron Planer from 38 inch to 42 inch with bed from 8 to 12 feet. These tools must be strictly first-class and at a low price. Address "SECOND HAND," care MACHINERY, 9-15 Murray St., New York.

14 inch Manufacturers' Sensitive Drill No. 1.

Will drive from No. 0 to 1-2 inch drill. Will drill to the center of 14 inch circle.



Designed to meet the requirements of manufacturers who want a thoroughly well made tool at a moderate price. The Spindle is a special forging made from high grade spindle steel. It is entirely relieved of belt strain and is counter-balanced by a weight inside of column which makes it extremely sensitive and uniform to the touch. The table and spindle head are both adjustable on slide. The bracket carrying the driving cone pulley is securely bolted to base of machine, thus preventing vibration of column when machine is running. A thoroughly well made and reliable overhead counter-shaft furnished with machine, and included in the price.

D'AMOUR & LITTLEDALE MACHINE CO.,

135 Worth Street, (cor. Centre Street,) New York, U. S. A.

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